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A Momentous Investigation

THERE will begin in Washington next Monday hearings that may have a most important influence upon one of the leading American industrial activities—the operation of our railroad system. The last session of Congress authorized, in accordance with the recommendation of the President, a joint commission of Senators and members of the House to review the railroad situation with reference to government regulation and government ownership. If predictions are correct, the railroad representatives will make some very far-reaching recommendations, while from the public's side one may expect all sorts of fantastic plans. It is too much to expect, no matter how thorough the hearings, that any quick solution of our railroad ills will result from the committee's work. Its report, however, should be the starting point, at least, of a better handling of our railroad problem. Relief is needed. Let us hope that the work of the Newlands committee will bring to regulators—state and national—a realization of the real needs and the fundamentals of a correct solution.

Experts Overnight!

THIS JOURNAL has had occasion in the past to criticise the practice of cities sending committees of laymen on trips of inspection, presumably for the purpose of securing data upon which to base recommendations for public-works construction. A recent press report from a Middle Western city states that a party consisting of two aldermen, the city attorney, two commissioners and two members of a township board has begun a pilgrimage—at the city's expense, it is safe to infer—for the purpose "of making a further investigation of sewage-disposal plants in the East." We are informed that this delegation "will visit Brooklyn, Rochester, Philadelphia, Boston, Cleveland, Akron and other Eastern points where sewage-disposal plants are in operation." What a merry little junket this will be! And think of the valuable data on the technical features of sewage treatment which these studious aldermen and township-board members will amass during their trip! How the city will profit by the advice these officials will bring back with them! They will become sanitary experts almost overnight. What need for a town to engage a consulting engineer to solve its technical problems when aldermen, city attorneys and commissioners are available—and in fact eager—for this service? Of course the city will pay a fat expense account in railroad fares, hotel bills and "sundries," and may be forced to replace ill-advised apparatus which experience shows will not work. But what does this amount to as compared with the broad education in sanitary engineering which the aldermen and the city attorney will have received?

The Concrete Institute

AS READERS of this journal well know, the American Concrete Institute has passed through many vicissitudes. Two or three times powerful friends have come to its support and lifted it out of bankruptcy. The management was inefficient, however, and again and again it slipped back. Now it appears a better day has dawned. Since the transfer of the management to Boston, the finances have reached a sound basis. Funds are on hand for publishing the three delayed volumes of proceedings and all of them are to appear before the close of the year. The committees are displaying a new activity, a good promise of a worth-while convention next February. The present condition of the institute warrants for the organization a wider support than it is receiving. Despite its past financial disabilities, it has rendered invaluable service. Its work on the method of finishing concrete surfaces, on insurance, on standard specifications for various forms of concrete construction has been notable and useful. In order that this work may be continued and the scope enlarged, engineers and contractors interested in concrete work should lend their support financially and morally, by taking membership in the institute and participating in the committee work.

Educational Efficiency

THE outside investigator generally commands attention when a man of equal ability in the organization or community cannot get a hearing. Possibly, then, the report made by a commission for the Federal Bureau of Education on the higher educational institutions of Iowa may bring about a reform which local agitation was unable to effect. The commission investigated the whole question of higher education in the state and as part of its assignment considered the duplication involved in the maintenance by the commonwealth of two engineering colleges. The conclusion might readily have been anticipated. The commission disapproves of the duplication and recommends that the two schools be united. Iowa is not the only state which has this problem of duplicate institutions. Several of the other states are thus afflicted. Possibly in these states, too, the federal bureau's report may have a salutary influence. Incidentally, the summary, which is all that has been issued to date, recommends an "average departmental salary for professors and instructors" of $2,000. The summary does not explain what is meant by these words. The mere statement, however, is sufficient to secure the attention of all interested in technical education. Not only because of the larger problems it touches, therefore, but because of this intimate, though less important one, the report when issued is sure to receive very close scrutiny.

Political Reflections

IN the present political rejoicing and sorrowing there is opportunity for all right-minded citizens, irrespective of party, to join in felicitation over some of the results of the election. Returns indicate that despite extraordinary, and in some cases unscrupulous, efforts of the labor organizations they did not succeed in delivering to the President the labor vote. There were some results from the propaganda, without doubt, but the returns do not justify Mr. Gompers' hope of landing the whole labor vote in the Democratic column. Labor still insists upon thinking for itself. Other reasons for felicitation are found in two well-done deeds in Illinois. Frank S. Buchanan, congressman from the Seventh Illinois District, prominent for his labor activities and now under indictment in New York State, was defeated. Likewise Clyde H. Tavenner, congressman from the Fourteenth Illinois District, author of one of the bills to prevent the increase of efficiency in government establishments, will afflict the congressional halls no more. Despite what may be one's political faith, therefore, there is reason for all having some satisfaction over the results of the election. Without doubt, many such instances can be cited, but those referred to are distinct gains for better citizenship.

Radical Redesigning

FORTUNATELY for the ultimate success of the project, the original plan of the French engineers for the dam and power station at the Narrows of the Yadkin River was not completed. As described in the article on page 610, changes of a radical nature were found necessary when, after two years' cessation of work on account of the war, construction was resumed. Striking confirmation of the need for the changes was afforded after the relocation of the power house had been decided upon and the new foundation carried well along toward completion. The July flood, which caused such a large amount of damage throughout the middle South, did not spare the Yadkin River Valley. The flood water exceeded by 25 per cent the maximum flow assumed by the French engineers, and not only washed away construction equipment, but wrecked the old power-house foundation. The changes in design include the abandonment of a completed power house, the adoption of vertical instead of horizontal turbines, and the substitution of a bypass leading around a rocky ledge above the new power house for the inadequate wells and their connecting tunnels. On account of these changes, the description of the new work in this issue will be of more than ordinary interest to hydraulic engineers.

Pipe-Joint Leakage

SUPPLEMENTING his statement made at the convention of the New England Waterworks Association at Portland, Maine, two months ago, Frank A. Barbour, at the society's meeting in Boston last week, again emphasized the importance of a thorough investigation of pipe-joint leakage and urged members to forward to the committee of which he is chairman information which can be used in developing methods for reducing the enormous annual waste from this cause. His statement of the case, on page 616 of this issue, is so convincing that it should bring forth a hearty response from waterworks men who, in the past, have been too complacent in accepting great losses from leaking pipe joints as inevitable. Presumably a thorough diagnosis of the trouble will suggest a remedy, but before Mr. Barbour's committee can recommend improvements in present practice it must have all the facts in the case before it. Upon the members of the association rests the obligation of supplying them. It goes without saying that all loss cannot be eliminated and that the relaying of existing pipe-line systems is financially impossible. The committee's work will affect future rather than past construction. Nevertheless, waterworks men should realize that they are carrying the burden of the waste and that the present condition of affairs does not speak well for standards of management. Water unaccounted for, amounting to 20 per cent even in systems fully metered, should be analyzed and the causes responsible for this waste definitely determined. Thus far the data submitted to the committee have not been sufficiently specific to be of great value, although there is undoubtedly a large amount of information in the country which, with proper co-operation, could be made available. The committee's work suggests a number of interesting queries. Are lead joints, as ordinarily made, the best joints which can be developed? What effect has temperature upon pipe-joint leakage? Is the loss attributable in large measure to under-registration of meters? Is sufficient care taken in laying and testing pipes? If not, how can present practice be improved? Mr. Barbour estimates that pipe-joint leakage alone is responsible for an annual loss of more than $4,000,000 on 60,000 miles of pipe line in American municipalities. With the leakage in water goes a corresponding leakage in dollars. Surely the subject is important enough to warrant waterworks men enlisting their services in a campaign for making pipe joints more nearly watertight.

Co-operative Engineering Education in England

MUCH SPACE has been devoted in these columns for a year or more to the remarkable industrial awakening in England. The awakening concerns not merely the internal organization of manufacturing plants. This has, indeed, been given much attention, as have also the welfare of the workers and the relations between capital and labor. Of external factors scientific research and technical education have been given much consideration.

Discussing technical training before the Association of Technical Institutions late last month, Sir Trevor Dawson, vice-chairman of Vickers, Ltd., the shipbuilders, suggested a form of apprenticeship combined with technical training which is a counterpart of the Cincinnati co-operative engineering education system developed by Dean Herman Schneider. Curiously, if the published abstracts are to be trusted, Sir Trevor made no reference to the American experience with this type of education; nor did *Engineering* in commenting upon the address. One is led to suspect that they do not know that ten years of experience are available with that method of preparing men for the industries.

Sir Trevor suggests for the consideration of the association a plan whereby boys in pairs would alternate between the shop and the school. Instead of alternation in weekly or biweekly periods, as is the practice here, he proposes daily alternation. This does not affect the principle of the Cincinnati method, but imposes difficulties in the works which those who may attempt the scheme will quickly discover. Sir Trevor suggests, moreover, that the plan be put into effect with boys in their earlier years, or during what we would call the high-school course. At Cincinnati the plan is applied only with those of college grade. Nevertheless, the application of the method to high-school students would not be a novelty in this country, since the Fitchburg technical high school has been operating on the plan for about ten years. Moreover, New York City for two years has used the co-operative system in high-school work.

It is interesting to note, too, that Sir Trevor realizes keenly that special effort should be made to fit young men into the positions for which they are best adapted. How much again does this sound like an echo from Cincinnati! There, above all places in this country, has consideration been given to the guidance of students into right lines and to predetermination, if possible, of a man's aptitude.

For these reasons we most earnestly recommend to Sir Trevor and to the Association of Technical Institutions a careful study of the co-operative systems of education so successfully worked out at Fitchburg and Cincinnati. Our British brethren can save themselves much experimentation by drawing upon the ten years of experience available here.

Incidentally, those who have had a part in developing the co-operative system, and particularly Dean Schneider, may well feel gratified that the system has been put forward by so successful an industrial administrator as Sir Trevor Dawson and that it has had the hearty approval of Lord Haldane and of the British engineering journals.

Pulling Sheet Piles

THAT inverted hammers can be used to pull the longest steel sheeting, if it has been properly driven, has been conclusively proved in the removal of the cofferdam for New York City's Forty-sixth Street pier, described on page 627 of this issue. Here many 72-ft. piles came out with a direct pull of 40 tons, and it is doubtful if any but the key piles required more than the equivalent of 100 tons.

It is fair to say that the most troublesome feature of the use of steel sheet piling has been getting it out again after its purpose has been served. This problem has always been before the makers of steel sheeting, since the economy has generally depended on the salvage to be realized in extracting the piling at the end of the job. Pile-pulling mechanisms, from the old driver-foreman's expedient of facing two pile drivers across the piece to be pulled and jerking it out with both runners to the trench foreman's rig of a plank lever and chain, have been tried and developed. Washington patent attorneys have derived no small sum from eager inventors of apparatus for starting the refractory pile.

Some years ago, about the time the American contractor was ruining good hoisting engines in jerking out piles, a British firm was working on an extractor designed to reverse the process of driving, by hammering them out of the ground. This invention, a simple inverted steam hammer with a grip for catching the top of the pile, is now coming into wide use in England because the scarcity of timber has put a premium on old piles. Its American cousins, however, slumber undisturbed in the files of the patent office because an American contractor went the Britons "one better" on a New York subway contract by extracting his steel sheeting with the identical hammer (turned upside down) which had driven it. From that day levers, jacks, ginpoles, gallows frames and heavy cranes were out of date for pile pulling, although that fact is not yet appreciated in all quarters.

Like every new process, this method has been tried unfairly and judged wanting. One case that comes to mind is the government work on the Hudson River at Troy, N. Y., where relatively short sheeting failed to come out with the hammer. In this case the editor, who discussed the question with the men in charge, more than suspects a little prejudice against the method. Moreover, it is doubtful if the hammer equipment was in the best of condition, as frequent breakages caused much of the trouble.

Moreover, steel sheet piling can be driven on rock so that nothing will extract it. If the sheeting has been set out of plumb, driven down full length one piece at a time, has been seriously deflected at points by boulders or has been overdriven on rock so as to curl up at the bottom, the interlocks may become jammed so that it is a waste of money to unthread them. It has been demonstrated that driving on rock with a drop hammer is likely to produce this result, and also that it is worse than useless to beat on a pile with an air hammer after the sound clearly indicates that rock has been struck. The curled, bent and split ends of the few piles that were overdriven at the Forty-sixth Street pier and the extreme difficulty with which they were pulled form an object lesson to contractors and pile inspectors.

If simple and well-known precautions are taken to avoid these troubles, not only will a stronger cofferdam be secured with less effort, but the deepest cofferdam ever driven can be pulled at a profit with inverted hammers. In short, it is not the ground friction, which can always be relieved by jetting, but the interlock friction that offers the real resistance to pulling steel sheet piles. Experience with the longest steel sheeting yet put down has proved that proper driving can keep this friction for all but key piles well below the equivalent of a steady 75-ton pull, a matter within the capacity of a 15-ton derrick equipped with an inverted hammer.

New Jersey's Roads

NEW JERSEY was at one time the premier state in the matter of good roads. It was the Mecca for those who wanted to learn about design, maintenance and administration. But that was all changed by the advent of the automobile. Designs were inadequate for the new service demands; administration broke down when roads ceased to be merely local-circulation avenues and became carriers for through traffic that knew not the bounds of townships or even counties. And for five years New Jersey has continued to drop back in the list of good-roads states. There has been no lack of highway work, nor of the expenditure of money; but the work has been poorly planned and the funds inefficiently spent. Now the state is taking inventory of its highway situation, in order to map out a sound and far-reaching policy. A commission will report its findings to the governor this winter, and while it has been at work the State Chamber of Commerce has likewise been making studies, co-operating with the official body. Extracts from the chamber's report will be found on page 623.

While the document shows that more than $100,000,000 has been spent on the state's improved roads, with little to show for the expenditure, the most important statements relate to the inefficient administration responsible for present conditions and to the financing of the future system. Not less than 500 different authorities, unco-ordinated, frequently unsympathetic, are spending the people's highway money. That fact is sufficient to explain conditions.

On the matter of financing we commend to the attention not only of engineers but to public officials that part of the report which condemns bond issues for road work. We know of no plan that will force a closer scrutiny by the public of road expenditures than of putting the financing on a tax rather than a bond-issue basis. In that direction only lies escape from excessive highway costs and a future financial burden that may seriously interfere with public-works expenditures in the next generation.

A Profit-Sharing Plan for a Gas Company

A PROFIT-SHARING plan in the operation of a public utility is an inducement to consumers and an encouragement to capital. There are justifiable differences of opinion as to the fair basis of division, but the Engineering Record has no hesitation in commending the principle as a wise element in sound public policy. In the new franchise terms for the Peoples Gas Light & Coke Company of Chicago, which are now under consideration, a distribution of earnings to users of the service is a conspicuous feature. It is of particular interest because of the changing conditions in the gas industry and the opportunity which they offer to put that utility before the public as a representative of modern spirit and enterprise.

It is true, of course, that profit-sharing arrangements can be appraised at their precise value only after a demonstration of their worth in actual experience. The individual cases, however, are the foundation of the broad doctrine that a division of earnings is popular with the public. The proposition of the Chicago company is that all normal operating expenses as heretofore are first to be deducted; then bond interest and 6 per cent per annum on future securities issued under authority of the Illinois Public Utilities Commission are to be allowed; and the remainder is to be divided in the proportion of 85 per cent to the company and 15 per cent to consumers in rate reductions. Certainly the principle of sharing the profit with consumers is commercially wise, and it will stimulate consumption.

In several respects the proposition of the Chicago company is notable as an exposition of the changing conditions in the gas industry. It illustrates in a large way the purpose of the pending movement to apply more modern commercial and rate-making ideas to the old established gas utility. While the tangible result of the proffered terms, if accepted, will be a reduction in rates in Chicago, the result, which will be of greater significance to the country at large, is the conspicuous progress in transition from a lighting-unit standard to a heat-unit standard, with all that this implies of benefit to the industry generally. Instead of a flat rate of 80 cents per 1000 cu. ft., there will be a sliding scale schedule based on a primary rate of 75 cents for an initial monthly consumption varying from 2100 to 6000 cu. ft., according to the meter capacity; a secondary rate of 65 cents per 1000 cu. ft. for the next 7000 cu. ft. and a tertiary rate of 35 cents per 1000 cu. ft. for the excess. A minimum monthly charge varying from 45 cents to $1.20, according to the meter capacity, will be made. Such a differential system of rates, graded according to the volume of consumption, means the use of gas for industrial purposes on a scale which would be impossible under the flat rate.

For years the gas industry has seen its business in illumination drift in increasing amount to the electric utility, which had the advantages of novelty, convenience, popularity, ease in adaptation to varied requirements, and last but not least, persistent advertising and commercial exploitation. Against the arguments of the electric utility the gas industry waged for a long time a losing contest. Electric utilities expanded rapidly and steadily, partly because of scientific rate-making, which automatically encouraged consumption. While the gas industry clung generally to the flat-rate system, the electric utility reached into the limitless field of industrial power and even heating by reducing its rates for larger-volume consumption. More recently the companies selling manufactured gas have given increasing consideration to the possibilities of scientific rate-making, and advance in this direction is reported in several localities. The Wisconsin, Massachusetts and New York (Second District) public regulating commissions have approved—and in some cases ordered—the adoption by gas companies within their jurisdiction of the heat-unit basis instead of the lighting unit, thus furthering the progress toward larger markets which the gas industry is now anticipating.

Other features of the arrangement which the Chicago company has proposed to the city authorities are in harmony with its advanced attitude on profit-sharing and rates. Necessarily, the plan involves the construction of a plant for the manufacture of coal gas, coke and byproducts. The required expenditure is estimated at $12,000,000. This heavy capital outlay would equip the company to provide gas for public consumers and also to make the coke and the valuable byproducts for which it would be able to develop a market. It would be a serious omission to minimize the value of plants so equipped for the national defense in the event that this country should be in peril of invasion. Our gas industries, of course, must be so operated as to justify themselves commercially—in other words, to pay—during the normal times of peace. If while rendering the service which the public demands they can in addition be potentially of great military advantage, this is good national insurance.

As a whole, the offer which is now receiving consideration is of unusual importance. It represents a commendable public-spirited effort to develop the natural markets of a gas utility located in a large community requiring varied and graded services; to stimulate the gas industry by the application of manufacturing and commercial ideas that shall enlarge its functions, and to meet the public cry, which frequently arises without regard to possible higher costs, for lower rates.

Modern Turbines and New Power House Replace Earlier French Design of Yadkin River Power Project

Twin Tunnels and Vertical Wells in Sidehill Rock Planned for Flood Flow to Be Abandoned and Bypass Used—July Flood Justifies Engineer's Decision

RADICAL changes in the earlier design by French engineers mark the American engineer's solution of the problem of completing the Yadkin River dam, 200 ft. high, begun in 1912 for the Southern Aluminum Company. A spillway for passing flood water over the dam was added; the new power-house location and layout involved the abandonment of a nearly completed structure; vertical turbines were designed instead of horizontal turbines, and old runners were remodeled, and a bypass for flood water is to be used instead of two vertical wells 60 ft. in diameter connecting with twin tunnels already completed.

This dam is located at the Narrows, near Badin, about 30 miles southeast of Salisbury, N. C., and is now approaching completion at the average rate of seven lifts, or about 2500 cu. yd. of concrete per day. It is expected to begin operation early next year. The Tallassee Power Company, a subsidiary of the Aluminum Company of America, bought out the French company after the latter ceased construction owing to war conditions in 1914, when the power house had been practically completed and about 50,000 cu. yd. had been placed in the west end of the dam.

NEW DESIGN JUSTIFIED

Striking confirmation was afforded of the soundness of the decision of the company's engineer to abandon the old power house and the twin tunnels originally intended for discharging flood waters, when the high water on July 15 (the biggest flood since 1814 according to marks set over 100 years ago) carried out several of the contractor's derricks, flooded and overtopped the cofferdams, washed out the railroad trestle and nearly carried away the 150-ft. steel span of a construction bridge on the downstream side and wrecked the east wall of the original power house. The new power house, with parts of one of the 27,000-hp. units already in place, came through the flood without injury.

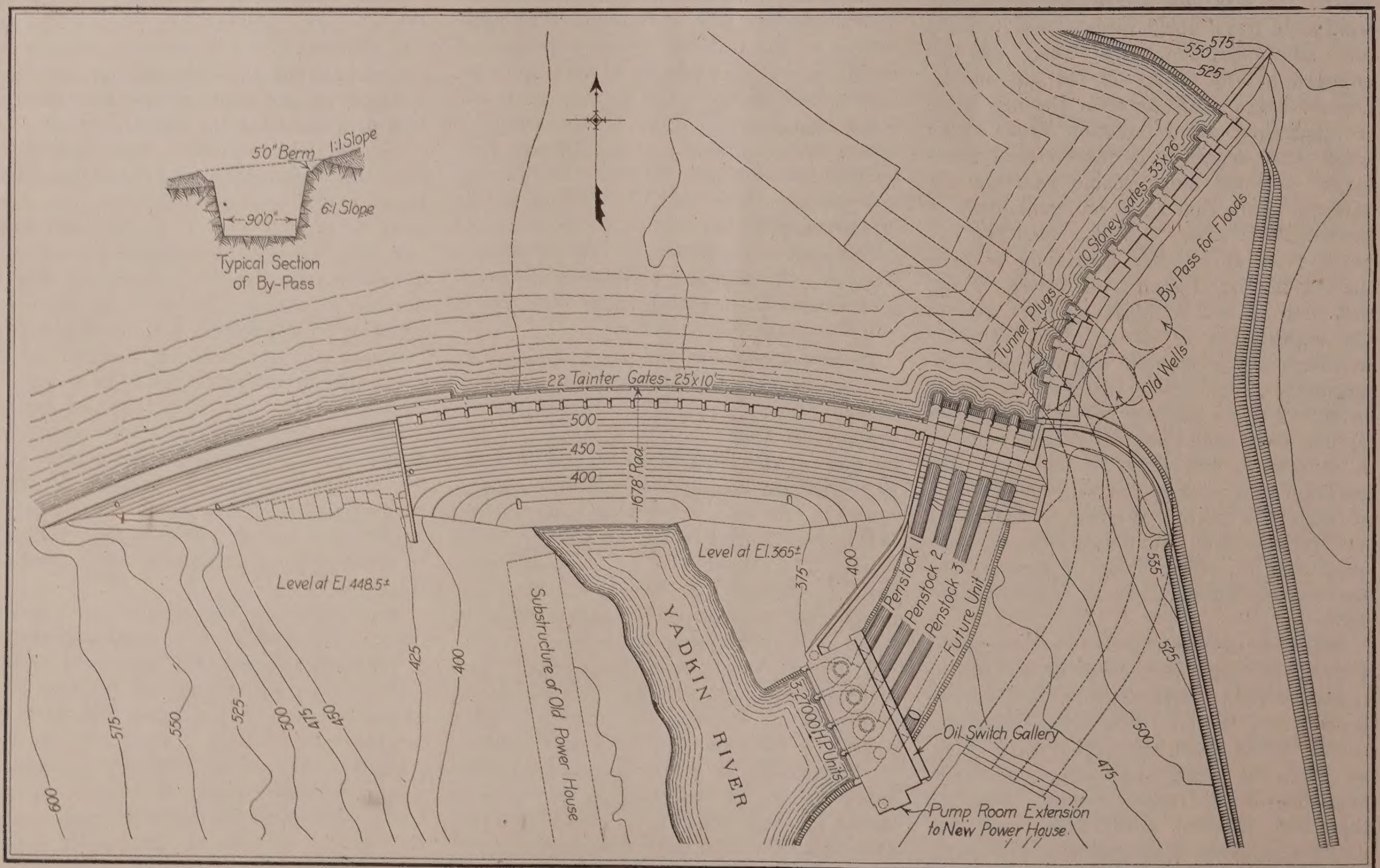
CONSTRUCTION FEATURES

The main construction features of the dam include the placing of alternate sections by the use of guyed derricks handling 2-yd. or 4-yd. buckets brought to the work by dinkey engines and flat cars from two concrete plants—one of which contains two 4-yd. Smith mixers, the largest in the country. Belt conveyors transport sand from a hillside storage pile to the mixing plant. Economy is found in the use of unit-slab forms so bolted to the displacers embedded in the concrete that ease of removal and rapid shifting is attained.

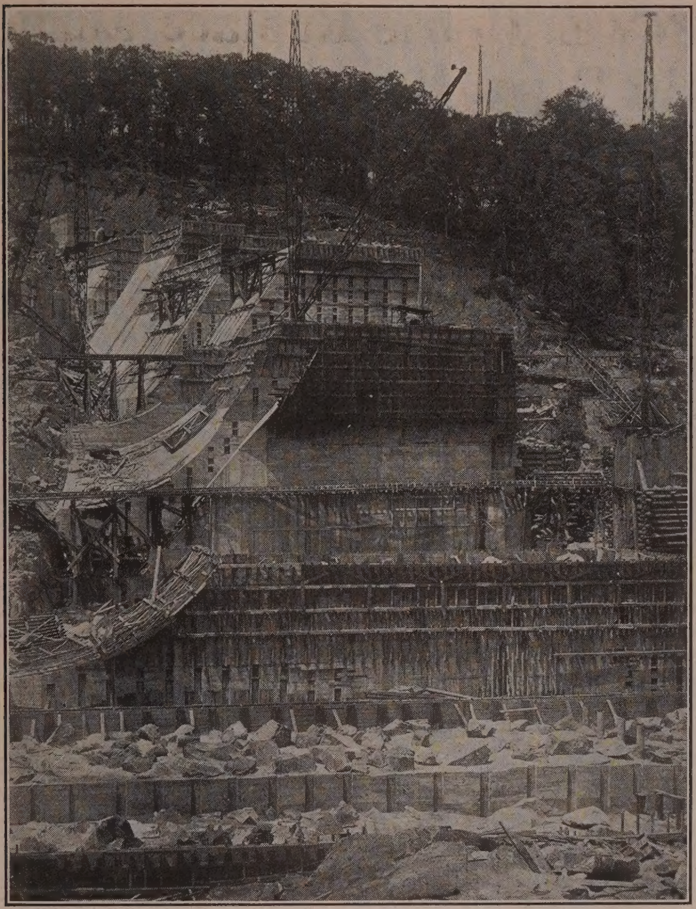
The design of the dam and flood gates, with runoff provisions, contemplates a safety factor 100 per cent greater than the biggest flood since 1898 and 65 per cent greater than the biggest flood of the past century. Arch section was not considered in the computation of the main sections, which were analyzed as for a pure gravity type.

BRIEF HISTORY OF PROJECTS

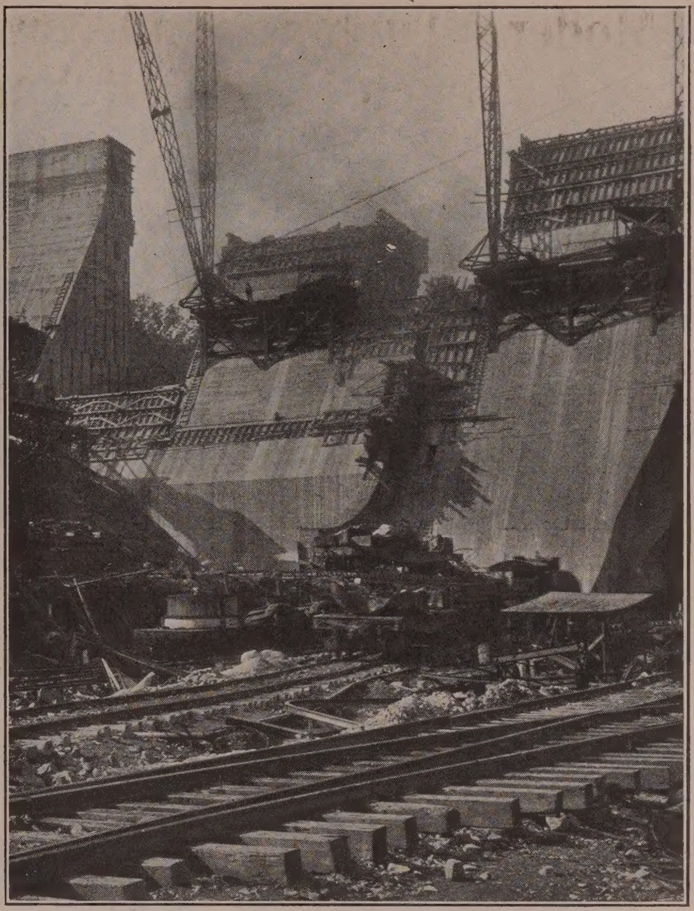
The earliest attempt to develop the power at this portion of the Yadkin River, where the fall is about 25 ft. per mile, was by George Whitney, who in 1908, with Pittsburgh capital, started an elaborate cut-stone masonry dam about 38 ft. high across the river 4½ miles above the Narrows. This work was abandoned in 1910 and, except for salvage of stone now being taken out, will be a complete loss. In 1912 the Southern Aluminium Company, controlled by French capital, started work on a high dam at the Narrows with the object of developing about 90,000 hp. The French engineers placed the power house on the west side of the river and designed it for twin-runner center-discharge turbines on horizontal shafts. They provided for flood flow by designing two vertical wells 60 ft. in diameter connecting to rectangular twin tunnels 40 ft. wide and 34 ft. high driven in the sidehill rock on the east side and used as diversion channels during the construction of the dam. These were completed by the construction company, timber and rock cofferdams were built, the power-house foundations of concrete completed, the steel frame erected, and about 50,000 yd. of cyclopean



PLAN OF DAM SHOWS LOCATION OF OLD AND NEW POWER HOUSES, AND TUNNELS AND WELLS OF THE EARLIER DESIGN



VIEW OF DAM ON JUNE 4 SHOWS VARIOUS STAGES IN CONSTRUCTION



DERRICKS RAISED TO TIMBER PLATFORMS ON DOWNSTREAM FACE

concrete placed in the dam on the west side, using a 1:3:5 mix. When the war broke out in 1914 all work ceased on account of war conditions.

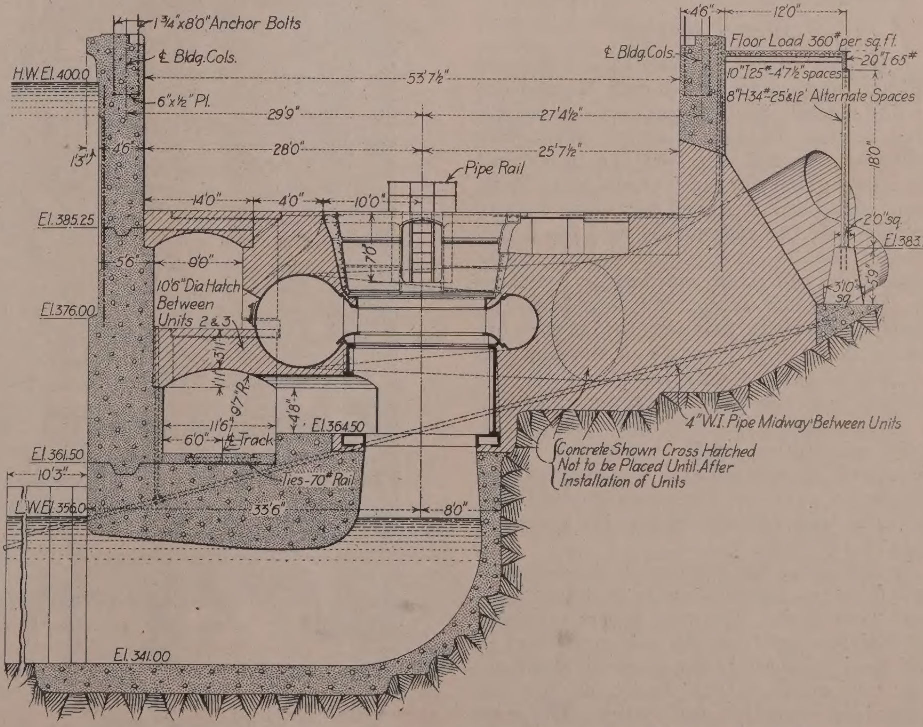
The Tallassee Power Company bought out the French company in 1914, and began work on the completion of the project in January, 1916. This company's engineer decided to use the part of the dam already completed, but to abandon entirely the original power house and flood-water provisions of the French engineers, just described. It was felt that the French engineers did not provide for a large enough flood and that the tunnels were unsafe. Hence it was necessary to build the bypass and also provide for part of the floods by a spillway over the dam. The old power house was only 20 ft. from the toe of the dam, entirely too close for safety, as the standing wave below the dam would wreck the foundations. The French engineers did not contemplate passing any water over the dam, so that the old power-house location was all right for such conditions. The discharge from the tunnels during floods would interfere with the flow of water that passed over the dam, and this would cause a dangerous rise of water in the river opposite the old power house and would have wrecked it had the old scheme of using the tunnels been adopted.

This view of the French engineers' inadequate provision for floods was vindicated when the 1916 flood, about 25 per cent greater than the maximum flood assumed by them, wrecked their power-house foundation.

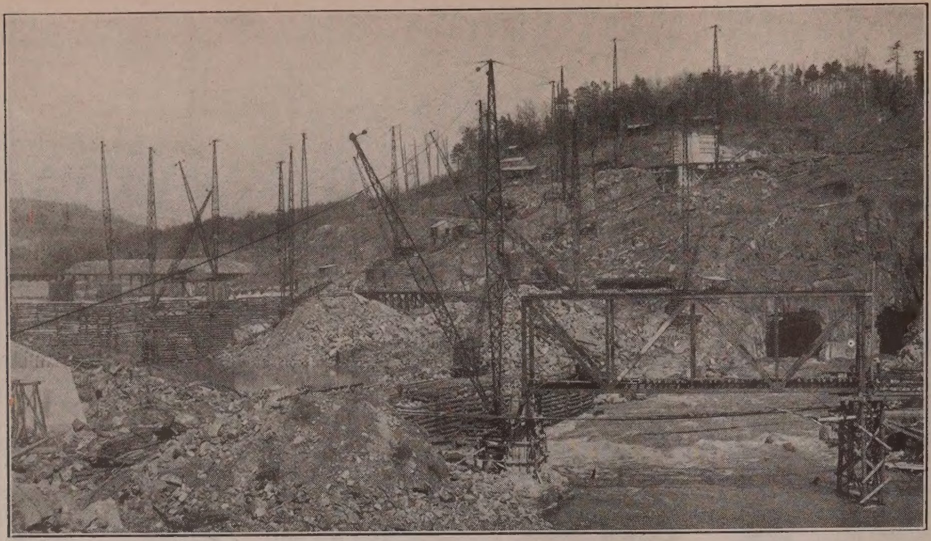
NEW POWER HOUSE

The new power house, placed on the east side of the river, is 180 ft. long and 57 ft. wide as before, so that the old steel frame could be used again, the columns being reinforced by steel channels on the inside. The foundations are entirely remodeled to conform to vertical-shaft turbines direct-connected to alternating-current 13,200-volt 36-cycle generators of 27,000 hp. each, three units to be installed now and one unit later. The 5200-kw. direct-current 520-volt generators for the original power house were remodeled into rotary converters, a change which necessitated the odd frequency of 36 cycles. The four draft tubes, after making the usual bend of 90 deg., discharge from the west side of the power house. A complete system of air tunnels provided for the cooling system is located above the draft tubes to keep the hot air out of the generator room.

Design of turbines and generators was based upon a minimum head of 165 ft. and a maximum head of 180 ft. Railroad facilities will be provided by a track over a



CROSS-SECTION THROUGH CENTER OF UNIT, SHOWING POWER-HOUSE FOUNDATIONS



ERECTING STEEL SPAN FOR DOWNSTREAM CROSSING—UPSTREAM CROSSING IN BACKGROUND

BUILDING FORMS FOR DRAFT TUBES

bridge crossing the river and entering the power house at floor level. Two 50-ton cranes are installed, with 10-ton auxiliaries, and access to the wheel chamber is permitted by a tunnel and adit in the concrete encasement. The turbine setting is designed for removing a runner from the lower side of the turbine by telescoping the cast-iron part (the top) of the draft tube into the lower (or concrete) part of the draft tube. This arrangement provides for renewing a broken runner without moving any of the generator parts. Riveted steel scroll cases are embedded in the foundation concrete.

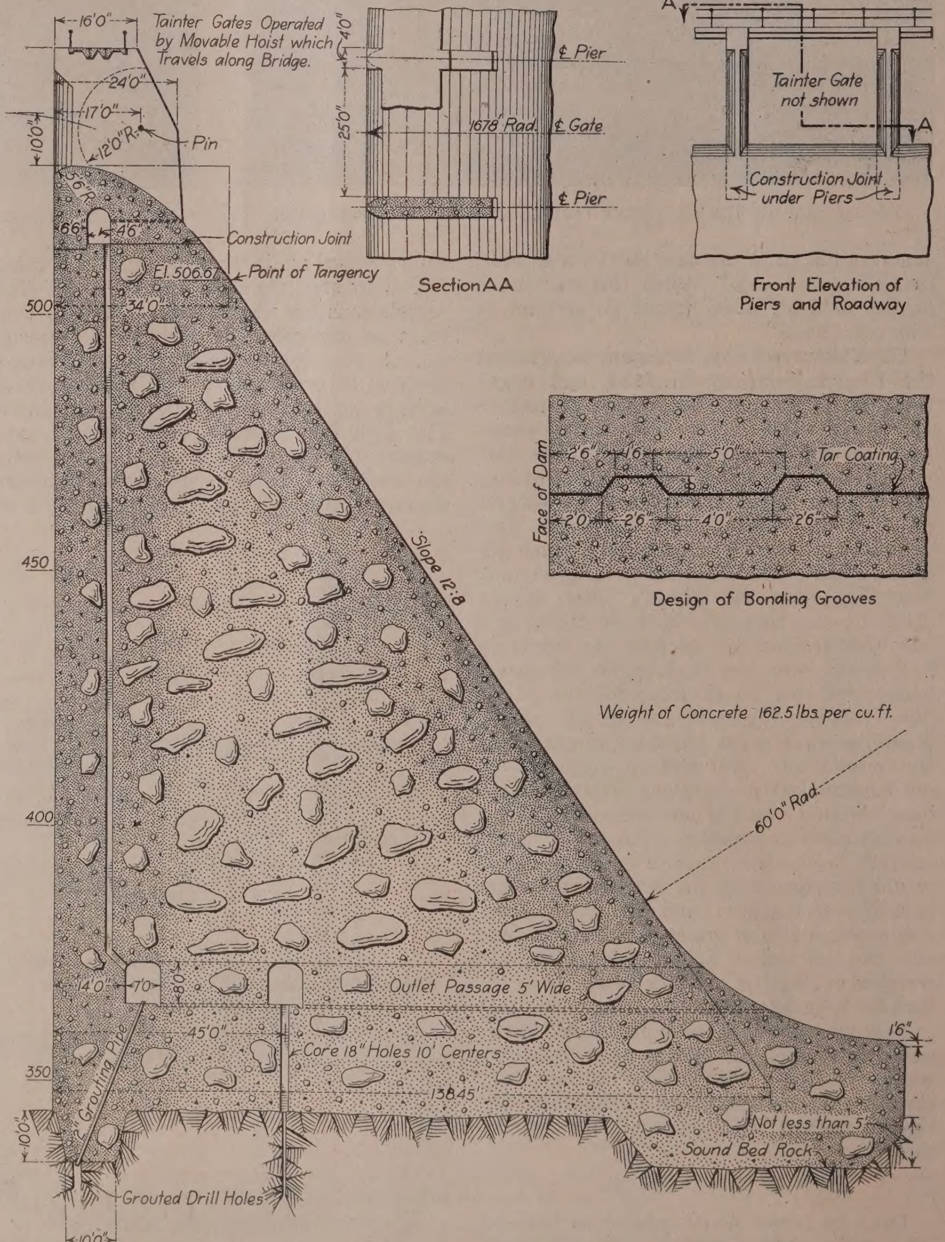
The construction of the power-house superstructure is being done by the company forces. Concrete from the downstream plant is used in the foundations. The brick walls and rolled-steel sash are being placed, a dark-brown mortar obtained by coloring matter improving the appearance of the brickwork. Air drills are removing the rock ledge in the tailrace, the rock being sent to the crushers and incorporated in the concrete or embedded as large blocks or displacers in the heart of the dam.

DESIGN OF DAM

Although curved in plan to a radius of 1678 ft. and supported by rock foundations on the sidehill, arch action was not considered in the design. Vertical contraction joints in a radial direction are introduced by constructing alternate blocks 45 to 50 ft. long, each block designed as a pure gravity section. At the ends of the dam the downstream face is curved to throw the water toward the central stream bed, as indicated by the contours on the plan view herewith. Bonding grooves between the blocks are spaced about 5 ft. apart, and the concrete surface is painted with tar to prevent adhesion, thus insuring contraction cracks in a vertical plane and preventing any possibility of interior uplift on diagonal cracks developed by contraction. Drain holes and inspection galleries, shown on the sectional drawing, were introduced near the upstream face of the dam.

In analyzing the stresses in the dam several different assumptions as to water pressure were made. The most severe case considered was uplift at the heel equivalent to full head of water in the reservoir, decreasing uniformly to full uplift at the toe caused by maximum tail water. The least severe specification assumed was that considering no uplift whatever beneath the dam. These two extremes were varied so as to study every possible combination of water pressure and uplift, but in no case was the arch action considered as lending stability to the structure.

Holes for grouting were drilled from 30



MAXIMUM CROSS-SECTION OF DAM—DETAIL OF BONDING GROOVES to 40 ft. into the ledge along the upstream side of the dam. However, grouting was not done until the concrete had been carried up approximately 50 ft. above the ledge to provide sufficient weight upon the foundations to prevent the grouting pressure from blowing out the rock. This grouting was done from the upstream lower inspection gallery, pipes for the purpose being carried up from the open drill holes to this gallery. The grout holes were 10 ft. on centers. For the most part a mixture of grout consisting of 1 part water to 3½ or 4 parts cement was used, grouting being done under a 95-lb. pressure. As the rock underlying the dam is unusually dense, very few seams and cavities were discovered in grouting.

SAND STORAGE AND CONVEYOR

Sand at the rate of 900 yd. per day hauled 60 miles by rail, in itself makes a problem in storage and handling at this site, where the concrete plant is about 200 ft. below the railroad. By building a simple timber retaining wall on the hillside and using a timber trestle, the cars are dumped into a 15,000-yd. storage space. A 16-yd. hopper was built and a guyed derrick with three-drum hoists to operate a 1½-yd. grab bucket keeps this hopper filled. A Robins belt conveyor 18 in. wide carries the sand about 800 ft. by gravity, with motor control to prevent runaway of the loaded belt, to the bottom of the hill. A second belt on an uphill slope to the storage bins at the upstream mixing plant is operated electrically.

Two stone quarries were established downstream, and a tunnel section was left through the dam to allow the rock to be transported by skips on the flat cars to the upstream mixing plant, where stone crushers are located. The cement is delivered by train, and stored in a timber storage house at the plant. Two plants are being used; the upstream plant on the west side consists of four 2-yd. Austin cube mixers and the downstream plant of two 4-yd. Smith mixers located on the east side of the river. The concrete is mixed rather dry, and 1½ min. is required in the mixer. Cement storage for 50,000 bbl. for one month's use is provided, 40,000 bbl. at the upper plant.

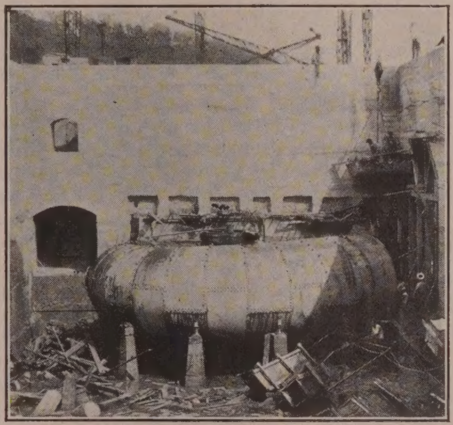
FORTY-THREE DERRICKS ON JOB

All materials are handled by the American Hoist & Derrick Company's guyed derricks and by buckets or skips on cars, as indicated in the photographs. Forty-three derricks are used, twenty-eight at the dam, two at the downstream mixing plant, two at the east quarry and eleven at the west quarry. These derricks generally have masts 115 ft. high and 100-ft. booms; 65 miles of guy wires are used and 15 to 16 miles of railroad track. Twenty-two dinkey engines haul 100,000-lb. flat cars carrying six 2-yd. or four 4-yd. concrete buckets or the skips filled with displacers. The rock is either transported to the crushers or picked up by the derricks and deposited in the concrete of the dam, using blocks from 2 yd. up to the 15-ton capacity of the derricks.

As the alternate sections are completed to greater heights than the derricks in their original positions on the low cofferdams can reach, new positions are provided on the downstream face of the dam by inserts in the concrete. These are occupied by the derricks, and the upper lifts of adjacent blocks poured by the intermediate derrick. All these derricks are operated by compressed air. A compressor plant of eight units with 8-in. main on the west side near the top of the hill furnishes this air through long pipe lines.

Cyclopean concrete, using a mix of 1:2½:5 determined by test to give maximum strength for the materials used, and about 22 per cent displacers form the dam proper, carried down to the solid rock, as shown by the cross-section herewith. The displacers are any size up to 15-ton weight placed 6 in. from each other or 2 ft. from the outer forms. Alternate blocks are constructed in lifts of 5 ft., the unit forms being 6 ft. high and 16 ft. long, fastened as indicated by one of the photographs (see "Hints for the Contractor" pages of this issue). The overlapping of the lower form over the one above and the use of one rod and blocks at the intersection of adjacent units resulted in great economy in form setting. About 250,000 cu. yd. has been placed, out of a total of 490,000 cu. yd.

As already mentioned, the new design contemplates the abandonment of the inadequate method of providing for flood flow by the twin wells and tunnels on the east side. Instead, it was found that the rock formation made the excavation of the bypass around the east end quite simple. This requires only a short curved guide wall of concrete connecting to the east end of the dam, and the construction of eleven concrete piers for the flood gates, which are of the usual Stoney type, 35 ft. wide by 26 ft. high. Concrete is hauled across the river over the upstream bridge and by switchback up to this level. The old wells were filled with rock after the lower ends had been sealed with concrete arches 6 ft. thick at the crown. An 18-in. pipe was left in these wells to allow concrete plugs about 50 ft. long to be placed in the tunnels after the water is diverted to the closure tunnel near the center of the dam.



SCROLL CASE UNINJURED BY FLOOD

Water flooded interior of new power-house foundations after part of this unit was in place.

Closure will be made after shutting off the water from the twin tunnels now being used as diversion channels by building a cofferdam. and using a closure tunnel through the dam, where double steel gates have been installed near the center. These gates consist of 24-in. 100-lb. I-beams spaced to provide for pressure due to a full reservoir. This condition of loading could occur in case of a big flood immediately following the closure of the gates. The water impounded will probably be 12½ billion cubic feet and will back up about 5 miles. On the spillway, which is 640 ft. long, 22 Tainter gates 25 ft. wide by 10 ft. high will be used to increase the head. These gates are operated by a traveling hoist, as noted on the cross-section drawing herewith. The three 15-ft. steel penstocks seen in the photographs carry the water to the steel turbine scroll cases in the concrete foundations of the power house under a head of about 165 ft.

The work is being constructed for the Tallassee Power Company, a subsidiary of the Aluminum Company of America. Edwin S. Fickes is chief engineer, under whose direction the main works at Badin were designed, with G. F. Murphy as his principal assistant. William Hoopes, chief electrical engineer, and T. J. Bostwick, his principal assistant, elaborated the complete plans for the electrical installation. James W. Rickey, the chief hydraulic engineer, and Charles B. Hawley, his principal assistant, elaborated the complete plans for the hydraulic installation. J. E. S. Thorpe is the resident engineer at Badin, N. C. Mr. Thorpe is in direct charge of all work in connection with the Narrows dam. The work at Badin is in charge, under Mr. Thorpe's direction, of R. R. Stevenson. This work includes not only the building of the industrial plant but of the town. The Hardaway Contracting Company, Inc., of Columbus, Ga., is the contractor for all work at the dam; S. S. Scott is superintendent in charge. The contract for the bypass excavation was sublet to Rinehart & Dennis. The generating units were furnished by the Allis-Chalmers Manufacturing Company, of Milwaukee.

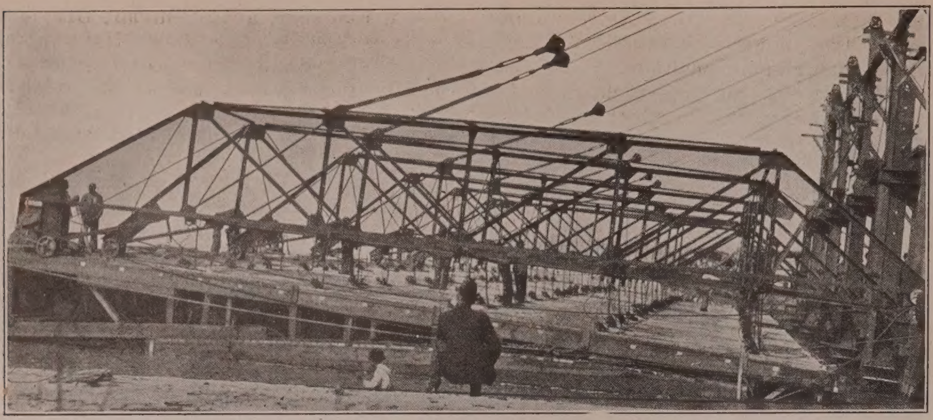
Make New Record in Mine-Shaft Work

Vertical Shaft at Homansville, Utah, Sunk Through Limestone and Lined for a Distance of 261 Feet in 31 Days

A VERTICAL shaft on the Homansville (Utah) properties of the Chief Consolidated Mining Company was recently sunk and lined for a distance of 261 ft. in 31 days. The shaft consists of three compartments, according to the *Mining and Scientific Press*, two of which are each 4 ft. 2 in. square inside and are used for hoisting skips. The third, or manway compartment, measures 4 ft. 2 in. by 3 ft. 2 in. inside. The lining consists of 8 x 8-in. timbers with 2 x 12-in. lagging, the sets being spaced 6 ft. apart. The material encountered was limestone varying from hard to soft and lying in almost horizontal strata.

The work was carried on by three shifts, each consisting of four machine men, one topman and one engineer. In addition to these, on the day shifts two timbermen put in the lining. Sullivan and Denver rock-drill sinking machines were used, the average drilling being about two 5-ft. rounds of 22 holes each per day. The hoisting was done by means of two 15½-cu. ft. buckets, used alternately. These were automatically dumped at the surface by a mechanism attached to the headframe.

The timbermen worked on what was termed a "suspended bulkhead and shooting set," which added to the speed and safety of the work. It consisted of a set of 8 x 8-in. timbers with ¼-in. sheet iron plates bolted on the bottom of the two outside compartments. This device was suspended by means of 1-ton chain blocks hung from two sets above. The tackle was long enough to allow the bulkhead to be lowered so that a new set of timbers could be put in place without stopping the work of the machine men and shovelers.



READY TO BEGIN THE LAUNCHING OF ONE OF THE 122-FOOT CONCRETE MATS

Experimental Concrete Revetment Proves Feasible and Economical

Major E. M. Markham Describes Plant by Which Eight Concrete Mats Have Been Constructed and Launched in Mississippi River

BELIEVING that concrete revetment for protecting the banks of the lower Mississippi would be more effective and durable than a fascine structure without necessarily being more costly, especially in view of the inadequacy of the willow supply throughout the lower river, Major E. M. Markham, Corps of Engineers, U. S. A., obtained from the Mississippi River Commission in 1914 an initial allotment of $2,500 for experimental revetment. Based on the results obtained from this a further allotment of $25,000 was granted the following spring. The experiments have convinced Major Markham of the feasibility and suitability of concrete revetment, and he describes and discusses them in the November-December *Professional Memoirs,* from which these notes are taken.

SLABS CAST ON BARGES

Under the first allotment eight concrete slabs were cast on barges with inclined decks. They varied in size from 14 x 18.6 ft. to 100 x 40 ft. All were 4 in. thick, reinforced by strand and mesh, variously clipped and wired together. Crude though this experiment was, it showed that the desired results could be obtained.

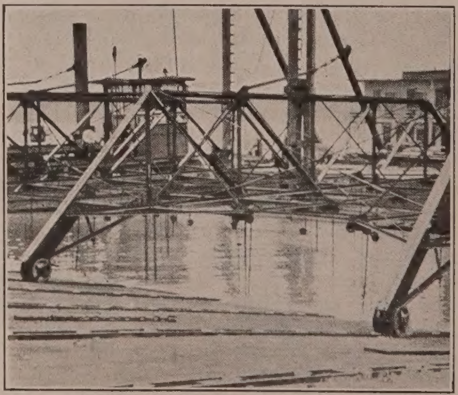
With the larger allotment in 1915 a plant was developed consisting of two barges on which to construct the slabs and a third to carry the necessary machinery to launch the slabs. The general proposition contemplated the formation of the slab or mat on the inclined deck of a barge, the barge later to be withdrawn under mechanical power, substitute support being simultaneously provided from a series of overhead trusses hinged upon a fixed mooring barge and having wheel bearings on ways of the barge withdrawn. Lines would run from the trusses to trip connections with loops formed in the mat. The mat would be lowered into the water between the barges and tripped when desired, control after tripping being provided by shackle connections from the upstream edge of the mat.

The slabs were to be reinforced with but strand and mesh, so that as they reached the bottom they would crack into irregular areas and thus conform to the inequalities of the bank. Subsequent erosion would cause further breaking up of the areas as the mat adjusted itself. The principal strand of the reinforcement would be extended to the high-water bank and anchored. Thus the revetment would be essentially monolithic from shore edge to deepest water.

Although for convenience slightly smaller sizes have been used, the plan was designed for slabs 125 x 50 ft. x 4 in. The barges were constructed so that with 180,000 lb. of water in a ballast compartment at the toe the upstream edge of the mat would start about 12 in. above the water surface upon the beginning of the mat-barge withdrawal, becoming submerged within a few feet of the movement. The several suspension lines are fixed of such length as to take weight only when it has been reduced to the extent of the water buoyancy.

Transverse ways 8 ft. 4 in. on centers are provided on the inclined decks of the mat barges, and between the ways platform sections are so mounted on supporting timbers as to be readily lowered or raised about 4 in. In the raised position these platforms are flush with butter or launching boards, about 11 in. wide, which themselves rest on rollers inserted in the ways. When the concrete in the slabs has sufficiently hardened the platforms are dropped, the slab thus resting entirely on the butter boards. To launch a slab it is therefore necessary only to overcome the axle friction of the rollers. The ways are steel shod to receive the wheel bearings of the overhead trusses.

The mechanical and structural equipment, which is mounted on a barge 124 x 30 x 7 ft., consists of a 35-hp. boiler, a double 7 x 7-in. engine, rigged with drums and winches, five intermediate trusses from which to suspend the slabs and two end trusses carrying sheaves and lines for manipulating the mat barge. All of the trusses are hinged near the downstream edge of the mooring barge and have wheel bearings upon the ways of the mat barge. They may be raised or lowered in unison. The trusses are of the five-panel-point Pratt type, spaced on 25-ft. centers, the interval being subdivided by side stirrups from each main truss. The mat is suspended from each panel point of both main trusses and stirrups, forming rectangles 8 ft. 4 in. x 10 ft. Thus there are five supporting lines across the mat, each involving fifteen suspension points.



LOWERING THE MAT FROM THE TRUSSES

LAUNCHING DETAILS

The supporting lines consist of ⅜-in. cable, end-wedged on the outside trusses, passing through two fixed sheaves and one movable sheave above each suspension point to drums of a shaft located on the center truss. Lines from one side pass under and those from the opposite side over the drums. Prior to launching the lengths of these lines are fixed for support of the mat at the desired submergence. As the mat lowers with the withdrawal of the barge, the supporting lines come successively into play and the total weight is automatically distributed. As a precaution against mishap involving the main plant, the strength of the mat loops and supporting lines is less than any element of the carrying structures.

The device employed at the suspension points, suggested by the Bucyrus Company, consists of a trigger attached to the housing of a movable sheave, and carries a pin held by a spring in a locked position. To hook up a mat for launching, this pin is withdrawn by hand sufficiently to pass the mat loop between pin and jaw. Connected to the tops of the trigger pins are chains attached to the overhead trusses, of such lengths as to retain the slack when the running suspension cables have taken the weight, all the chains being adjusted for as nearly the same amount of slack as is practicable. To trip the mat from suspension it is necessary only to throw the brake at the end of the shaft on the center truss, whereupon the weight of the mat itself overhauls all suspending cables, taking up the slack of the top chains, and the pins are pulled practically simultaneously.

HOW MAT IS CONTROLLED

To prevent the mat from moving with the barge when the latter is withdrawn, shackle attachments are made from its upstream edge to trolleys designed to travel vertically upon spuds of the mooring barge. The mat, upon being tripped, will therefore continue to be controlled with the withdrawal as desired of shackle pins. Backhold lines prevent the slab from racing off the barge.

Eight mats have thus far been constructed and launched. They were reinforced by ½-in. strand around the edges and on the lines of suspension and normal thereto, 5/16-in. strand running diagonally through the suspension points and triangular mesh over the whole area. The last six mats have each been 122 x 42 ft. x 3 in., weighing 192,000 lb. each.

The slabs were launched over a shelving bank in inshore depths of from 8 to 18 ft. and outer depths of from 20 to 50 ft. All reached the desired positions within reasonable limits of error. Three slabs launched during high water have since been partly exposed. They are to all intents intact, cracked only to the extent necessary to fit bank inequalities, which they follow very closely.

It is conservatively estimated that one handling plant should dispose of five or more slabs in a ten-hour day, at a probable cost of about 60 cents per square yard. A comparable figure for willow-fascine construction is from 70 to 80 cents.

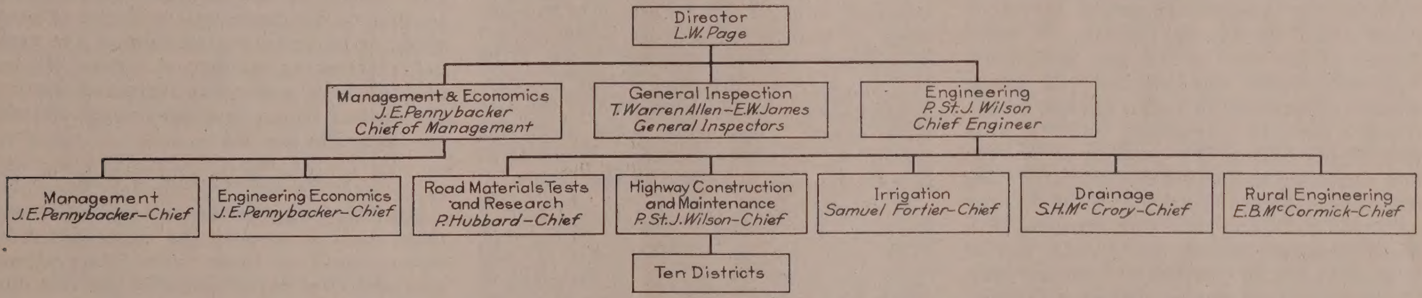
On the lower Mississippi fascine mattresses at least 250 ft. wide are installed. Concrete revetment in single sheets this wide is believed entirely feasible, as additional outshore dimensions would be met simply by additional supporting trusses and suspension points. A limit in the other dimension would be reached by the width of the mat barge and the length of the trusses.

U. S. Office of Public Roads Reorganized

Director L. W. Page Issues Memorandum Defining Various Branches of Department and Outlining Scope of Duties for Engineering Personnel

EFFECTIVE Nov. 1, 1916, the following instructions, issued by Logan Waller Page, director, are to govern the organization of the U. S. Office of Public Roads and Rural Engineering, the responsibilities of which have been vastly increased by the recent passage of the $85,000,000 Federal-Aid Road Act:

The organization of the office shall comprise two main branches—(1) engineering and (2) management and economics. The chief engineer shall have charge of the engineering branch. He shall report to the director, and in the absence of the director he shall be the acting director. The chief of management shall have charge of the management and economics branch. He shall report to the director, and in the absence of both the director and the chief engineer he shall be the acting director. The general inspectors shall inspect field operations upon instructions from the director, and shall report thereon to the director.



THE REORGANIZATION OF THE OFFICE OF PUBLIC ROADS INDICATED BY THIS CHART BECAME EFFECTIVE NOVEMBER 1

No change shall be made in the work in progress, nor shall any new work be undertaken by employees in either branch, except by direction of the chief of the branch involved. No employee shall conduct, except through his immediate superior, any official business with other employees. Instructions to the chief engineer and the chief of management shall be given only by the director or by the acting director.

Should the director find it necessary to make a suggestion or give instructions to any employee of either branch, such employee shall forthwith give to his immediate superior a written memorandum covering the suggestions or instructions, which memorandum shall be submitted promptly, through the proper channels, to the chief of the branch in which he is employed. This restriction shall not apply to general inspectors.

The organization as shown by the accompanying chart became effective Nov. 1, 1916.

ENGINEERING BRANCH

The engineering branch shall comprise the following lines of work: (1) Road construction and maintenance; (2) road-material test and research; (3) farm-irrigation investigation; (4) farm-drainage investigations; (5) rural engineering.

Road construction and maintenance shall comprise: (1) Road-construction and maintenance investigations authorized in the Agricultural Appropriation Act and (2) Federal-aid road construction and maintenance.

Road construction and maintenance investigations shall comprise: (1) Supervision of object-lesson road and bridge construction, (2) co-operative road maintenance, (3) maintenance of experimental roads and (4) inspection and advice concerning various field problems of road and bridge construction and maintenance.

Federal-aid road construction and maintenance shall comprise: (1) Post-road construction under the Federal-Aid Road Act and (2) surveys, inspection, construction, and maintenance of forest roads under Section 8 of the Federal-Aid Road Act.

District engineering work shall comprise: (1) All engineering work assigned to it by the chief engineer, including federal-aid roads, object-lesson roads, experimental roads, advice to state and county officials; (2) all surveying, inspection, and supervision of construction and maintenance work under Section 8 of the Federal-Aid Road Act in the National Forests in collaboration with the forester; (3) such studies of road economics, made at the request of the chief of management, as are assigned to the district by the chief engineer; and (4) such other duties as may from time to time be assigned by the chief engineer.

FIELD DISTRICTS CREATED

The following field districts, each in charge of a district engineer who shall report directly to the chief engineer, are established:

District 1 includes Washington, Oregon and Idaho; District 2, California, Nevada, Arizona, and New Mexico; District 3, Montana, Wyoming, Utah and Colorado; District 4, North Dakota, South Dakota, Minnesota, and Wisconsin; District 5, Nebraska, Kansas, Missouri, and Iowa.

District 6 includes Arkansas, Louisiana, Oklahoma, and Texas; District 7, Illinois, Indiana, Kentucky, and Michigan; District 8, Florida, Georgia, Alabama, Mississippi, South Carolina, and Tennessee; District 9, Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont; District 10, Pennsylvania, Ohio, West Virginia, Virginia, Maryland, and North Carolina.

Road-material tests and research shall comprise investigations, reports and advice upon (1) the chemical and physical character of road materials; (2) classification of rocks according to their mineral constituents; (3) standardization of methods of testing bituminous and nonbituminous road materials; (4) occurrence, manufacture, and properties of dust preventives and road binders; (5) nonbituminous road materials; (6) the use of concrete for road and bridge purposes; and (7) the making of field experiments.

Farm-irrigation investigations shall comprise investigations, reports and advice upon (1) the utilization of water in irrigation; (2) kinds of power and appliances for irrigation; (3) the development of irrigation equipment; (4) the flow of water in ditches, pipes, etc.; (5) the duty, apportionment and measurement of water; (6) customs, regulations and laws relating to irrigation and (7) the drainage of irrigated lands.

Farm-drainage investigations shall comprise investigations, reports, and advice upon (1) farm drainage; (2) the drainage of swamps and wet lands; (3) the removal of surplus water; (4) the development of drainage equipment and (5) the making of field experiments.

Rural engineering shall comprise investigations, reports, and advice upon (1) farm domestic water supplies; (2) drainage disposal; (3) construction of farm buildings; (4) rural engineering problems involving mechanical principles; (5) traction tests on highways and (6) construction and repair of instruments used in investigative work.

MANAGEMENT AND ECONOMICS BRANCH

This branch shall comprise (1) management and (2) engineering economics.

Management shall comprise the following: (1) Co-operation with solicitor's office; (2) correspondence and files; (3) accounting; (4) editorial and library and (5) quarters, equipment, and supplies.

Engineering economics shall comprise the following: (1) Economic investigations and advice; (2) legislative digests, compilations and advice; (3) statistical investigations; (4) lectures, addresses and exhibits and (5) model-making and illustrations.

Co-operation with the solicitor's office shall comprise the handling of questions of a legal and administrative character arising from the Federal-Aid Road Act and other legislation affecting the office.

Committee Wants Data on Pipe-Joint Leakage to Check $4,000,000 Annual Loss

Frank A. Barbour's Figures Indicate Excessive Waste in American Cities Which Might Be Reduced by Better Methods of Construction

STATISTICS indicating enormous annual losses to cities by leakage of water from pipe joints were presented at the meeting of the New England Waterworks Association in Boston Nov. 8 by Frank A. Barbour, chairman of the society's committee which is investigating this subject. If the members of the association co-operate in supplying information to the committee, this economic loss, it is believed, can be materially reduced. The following remarks by Mr. Barbour at the Boston meeting supplement his statement presented in September at the annual convention of the association in Portland, Me. (see Engineering Record of Sept. 23, pages 369 and 385).

20 Per Cent Loss in Metered Systems

In entirely metered systems, or in systems where the meters exceed 85 per cent of the services, at least 20 per cent of the water furnished is, on the average, unaccounted for. Should we be content with such a condition?

We all know that the total unaccounted for water in unmetered systems is enormous. Presumably we all agree that metering is the great remedy, and yet, as reported by the United States Department of Commerce, only 40 per cent of the services are metered in 201 cities, containing 26,000,000 people and having an average per capita consumption of 139 gal. per day.

The total population in the United States supplied with water from public works may be taken, for present purposes, at 50,000,000 people, and the average amount of water furnished per day at 100 gal. per capita. The total water supplied daily by public works is therefore, in round figures, 5,000,000,000 gal. It is probably safe to state that 50 per cent of this quantity is wasted; and assuming the actual cost of furnishing the useless 2,500,000,000 gal. to be $25 per 1,000,000 gal.—and this is an extremely low figure—the cost per day of the water wasted is equal to $62,500, or $22,800,000 per year, which is equal to the interest on an investment of $500,000,000. Figured in this rough way, the results do not speak very well for our present-day standard of management of water systems.

As already stated, metering is the great means of reducing the total waste on which the previous figures are based, but there remains the fact that in the fully metered systems, on the average, at least 20 per cent of the water furnished is unaccounted for, and probably if more accurate data were available this percentage would be shown to be materially greater. Emil Kuichling estimated 2500 to 3000 gal. per mile per day as the leakage from well-laid mains; Dexter Brackett estimated a leakage of from 10,000 to 15,000 gal. per day in the Metropolitan District, and John R. Freeman stated that his best guess of the underground leakage in New York was from 25 to 35 gal. per day per capita, equal to from 20,000 to 30,000 gal. per day per mile of pipe. In six cities, with 95 per cent of the services metered, reported by Brackett in 1904, 36 per cent of the water was unaccounted for, equal to an average loss of 11,300 gal. per mile of pipe. James H. Fuertes, in the 1906 report to the Merchants Association of New York, presented statistics from thirteen cities in which, on the average, 82 per cent of the services were metered, which showed that 31 per cent of the supply was unaccounted for, equivalent to approximately 18,000 gal. per mile of pipe.

What part of these losses is chargeable to the mains is unknown, but from the results of such leakage surveys as have been made, and from the reported actual losses discovered in some cities, it is probable that 7500 gal. per mile of pipe per day is a conservative estimate of the water lost by leakage from the 60,000 miles of mains now in use in the public supplies of this country, or 450,000,000 gal. daily. At $25 per 1,000,000 gal., this is equal to a daily loss of $11,250 or $4,110,000 per year, or the interest on $100,000,000.

Is Loss Preventable?

In the light of this economic waste it would appear that the subject of leakage from mains is worthy of careful consideration. The committee on water consumption of the New England Waterworks Association reported in 1913 that "in general it may be said that if in a well-metered system the water unaccounted for does not exceed 25 per cent of the total pumpage, the practice is good." Doubtless this should be interpreted to mean that a 25-per cent loss is good compared with the average present practice. But is it good compared with the standard which should be set up in this age when we hear so much about conservation? Should we complacently accept a loss of 25 per cent as inevitable, and if this loss cannot reasonably be much reduced in the systems already constructed, what about the possibility of better methods of construction in the pipe to be laid in the future?

It is, of course, out of the question to consider the relaying of present systems or to do more than make leakage surveys and check the larger losses, but in the light of present knowledge, is it not time to undertake seriously an analysis of the causes responsible for the present large percentage of water unaccounted for? If these losses are chargeable to under-registration of meters, then this should be definitely made known, and consideration given to the possibility of developing more sensitive or more accurate measuring apparatus.

Are we taking sufficient care in testing pipe for water-tightness when laid? About 60 per cent of those replying to the circular of the committee state that the pipe is tested when laid, and all but six make the test before backfilling. In the writer's experience, testing before backfilling in the ordinary work of laying distribution systems is rare, and it is undoubtedly from the practice of simply turning on the water without any test that a considerable part of the present leakage develops. The standard of those who test, as indicated by the replies received, is "absolute tightness," but in the writer's experience this result is not easy to obtain, and only possible where the joints are gone over several times after the pressure is applied.

Where pipes are backfilled before testing the allowable leakage, as determined by such tests, has varied greatly in different specifications. John H. Gregory at Columbus made the limit 500 gal. per inch-mile per day. At Akron 200 gal. per inch-mile per day was specified, while actual results at Akron showed about 70 gal. per inch-mile per day. E. G. Bradbury, in his paper before the New England Waterworks Association in 1914, proposed 100 gal. per inch-mile per day as a reasonable standard for the allowable leakage in testing after backfilling, and he figured that the difference between 500 and 100 gal. per inch-mile per day, estimating the cost of the water at $25 per 1,000,000 gal., would equal a yearly cost for water lost in a city of 100,000 people of $5,256, or, in other words, the city could afford to spend $470 per mile in order to save 400 gal. of leakage per inch-mile per day.

Are Present Jointing Methods Best?

Again, are the present jointing methods the best qualified to maintain tightness after periods of use? Who knows anything about the comparative leakage when pipe is laid and after it has been in service several years? In this latter connection the history of the work at Grandview, Ohio, is of interest. As reported by Mr. Bradbury, the supply is measured by a tested meter and all service pipes are metered. The 5.5 miles of pipe originally laid were tested before backfilling and the leakage before any connections were made amounted to 131 gal. per inch-mile per day; in other words, the system was practically watertight. Subsequently 0.9 mile of additional mains were laid, and gradually in the four years since the date of original construction the services have increased to the present number of 205. Either by less careful work in the extension or by depreciation of the original work, or by under-registration of the gradually increasing number of meters, the unaccounted-for water has increased until at the present time it averages about 150 gal. per inch-mile per day.

Unaccounted-For Water

An interesting feature in connection with these records is that the unaccounted-for water, based on three years' observations, averages 60 gal. per inch-mile per day during the six months from October to April and 213 gal. during the six months from April to October. In other words, the records indicate in this system that the unaccounted-for water is three times as great during the summer as during the winter months. Whether some local explanation can be found for this result, or whether it is a reasonable result of temperature changes is not known, but data from other systems showing the unaccounted-for water during periods of varying temperature would be of considerable interest.

Any information of definite tests of leakage from observation of mains after periods of use or of the effect of temperature on leakage or the results of tests of leakage from lead joints with different shapes of bell and spigot or of other types of joints will be of value to the Committee on Leakage, and it is hoped that if any members have such information they will forward it to the committee.

[*Data should be mailed to Frank A. Barbour, chairman of the committee, whose address is 1120 Tremont Building, Boston, Mass.* —EDITOR.]

Reaëration Held to Be Important in Self-Purification of Streams

Prof. Earle B. Phelps, of U. S. Public Health Service, Contends That Dilution Ratio Is Not the Essential Factor in Preventing Nuisances

THAT the dilution ratio is not the essential criterion in determining the capacity of a stream to receive sewage without causing a nuisance is the view expressed by Prof. Earle B. Phelps, of the U. S. Public Health Service, in a paper presented at the annual convention of the American Chemical Society in New York City, Sept. 27. Reaëration is a determining factor, and yet, according to Professor Phelps, it has received little or no scientific attention.

Underlying Principles

In his discussion of reaëration as a factor in the self-purification of streams Professor Phelps enunciates certain underlying principles:

1. Pure water exposed to the air, at given temperature, will dissolve atmospheric oxygen up to a maximum amount, this value being known as the saturation value.

The solubility of a gas in water is proportional to the gas pressure. Since the oxygen pressure in the air is approximately one-fifth an atmosphere, the true solubility of oxygen in water exposed to pure oxygen at atmospheric pressure is about five times as great as the so-called saturation value. In the presence of green plant life, exposure to nearly pure oxygen is frequently observed and oxygen values of several hundred per cent of saturation are frequently recorded. A correct knowledge of the true physical relation existing is quite necessary to the understanding of the apparently abnormal results which have often in the past been ascribed to faulty chemical analysis. The solubility of oxygen is also a temperature function. Tables of saturation values are to be found in any standard work on water analysis. Approximately 10 parts by weight of oxygen will dissolve in 1,000,000 parts of water at 16 deg. C., and the solubility increases roughly by about 2 per cent for each degree Centigrade decrease in temperature, and vice versa.

Oxidation of Organic Matter

2. Self-purification in a polluted stream is the result of the biochemical oxidation of organic matter and requires oxygen for its consummation. The more concentrated the organic matter the greater the rate of oxygen depletion.

American sewages have a biological oxygen demand of from 200 to 400 parts per 1,000,000. This means that if diluted with saturated water at 16 deg. C. they would exhaust the oxygen supply of that water in dilution ratios of 1 part of sewage in from 20 to 40 parts of water. With greater dilutions corresponding partial oxygen depletion will result.

3. A stream saturated with oxygen will withdraw no more oxygen from the atmosphere. If partly depleted it absorbs additional atmospheric oxygen, and the rate of such absorption or reaëration while dependent upon many other factors is directly proportional to the state of depletion.

4. Under any given condition of pollution and reaëration a point of maximum oxygen depletion is reached, somewhere downstream, at which the rate of depletion and the rate of reaëration are equal. This will be termed the critical point, since it determines the maximum effect of the pollution.

Above the critical point the oxygen content of the stream is diminishing, below it is increasing. The location of this point is evidently conditioned by the time of passage or by distance in hours rather than in miles. It is also a temperature function, since depletion is accelerated by higher temperatures. As the velocity of stream flow is usually at its minimum during the hottest months, the critical point moves upstream rapidly with increasing temperatures.

5. The condition of the stream at the critical point, representing a balance between rate of depletion and rate of reaëration, is at constant temperature, a function only of pollution and of reaëration.

6. The capacity of a stream to dispose of sewage within any specified limits of nuisance is obviously measured by the condition of the stream at the critical point. It is at a minimum at maximum temperature and minimum stream flow, and under fixed temperature and flow conditions is a function of reaëration.

7. The capacity of a stream for reaëration under extreme conditions of high temperature and low stream flow therefore measures its capacity to receive and dispose of sewage by self-purification within any prescribed limits of stream depreciation or nuisance.

In the past, although the relation of dissolved oxygen to the condition of a stream, as well as the fact of reaëration, has been fully recognized, the relations set forth in the foregoing principles have been partly or wholly overlooked because of imperfect ideas of the rôle of oxidation.

Application of Data

The application of observational data, obtained upon running and comparatively shallow streams where conditions are ideal for reaëration, to deep canals with sluggish flow and minimum reaëration conditions cannot but lead to unsatisfactory results. A large part of the residual oxygen found in streams of the former type can now be shown to have been derived from natural reaëration. If it be assumed that such residual oxygen was initially present and had not been utilized by the sewage, the capacity of the sewage to consume oxygen is thereby underestimated and the application of the data to streams of the second type with deficient reaëration will lead to insufficient dilution and a condition of nuisance not anticipated.

As early as 1900 Palmer found the dissolved oxygen at the lower end of the sanitary canal in Chicago in August to be 5.88 per cent of saturation, increasing to 70 per cent after passing the dam. Wisner reported in 1911 the frequent absence of oxygen for many miles above the lower dam at Lockport with a dilution of about 3.3 sec.-ft. per 1000. Passage over the dam increased the dissolved oxygen to about 19 per cent of saturation. The relative importance of dilution and reaëration will be appreciated if it be noted that simple passage over the dam had the effect of a 19 per cent increase in saturated dilution water, or was equivalent to raising the dilution from 3.3 to 4.1 sec.-ft. per 1000.

The problem of the moment deals not so much with the present conditions as with the future. It is of the utmost importance to determine the future effect of gradually increasing pollution upon any given stream. In connection with purification treatments it is highly desirable to know what degree of stream improvement may be anticipated from any specified degree of purification in order that the cost of various treatments may be properly balanced against the benefits to be expected. Finally there frequently arises the problem of the effect of a very large pollution of a hitherto unpolluted or slightly polluted area, following the location, for example, of new intercepting lines and discharge points.

The Reaëration Factor

The essential elements of the specific and the general solution are as follows: Determination of the extent of pollution at a given point, measured in terms of the new sewage chemistry which deals with oxygen relations, and of the degree of self-purification and amount of residual oxygen at some lower point, together with temperature and hydraulic data, furnishes the basic facts. The oxygen requirement and rate of oxygen depletion are then known. The condition of the lower station in the same terms is calculable. The actual condition compared with the calculated gives the reaëration factor for the stretch. This must be determined for the same stretch over a considerable period of time in order properly to include the variations in hydraulic conditions.

In particular reaëration is a function of depth, velocity of flow and degree of turbulence. Similar data may be obtained at the same time over other typical stretches and the relation of the reaëration factor to other physical and hydraulic conditions noted. From such a comprehensive study there will be obtained eventually the necessary data for the determination of the reaëration constant of the stream in question under various physical conditions. Then the result of increasing or decreasing pollution, always measured in proper terms of oxygen demand, will be readily calculable. Repetition of the study upon another stream will give similar data for that stream and also permit some study of the effect of stream type upon reaëration.

Sewage Capacity Without Nuisance

With accumulating data of this sort it is not unreasonable to anticipate that the fundamental constants will ultimately be derived with which the capacity of any stream to receive and dispose of sewage within stated nuisance limits may be determined in advance. Such constants furnish the only rational basis upon which to estimate the effect of increasing or decreasing pollution, or the degree of purification necessary or desirable in any case. As these matters have been shown to be of primary importance in any application of the principle of conservation to streams, the importance of work of this character is obvious.

In the foregoing discussion it will be noted that no reference has been made to either of two distinct phases of the pollution problem, the matter of dangerous bacteria and that of sludge deposits. Both are separate and distinct problems capable of solution independently of the problem of oxygen supply and leading to nuisances of distinct character. The presence or absence of these factors does not influence the methods or conclusions of this discussion, although the matter of deposits does enter the analytical problem.

EFFECT OF TURBULENCE

An important conclusion of this discussion will be touched upon briefly in passing. Reaëration is conditioned among other things by the degree of turbulence of the stream. In quiescent water a diffusion gradient is established which practically stops reaëration. The effect of dams and rapids in increasing aëration is not so much dependent upon the momentary exposure of the water as it is upon the mixing action whereby the diffusion gradient is broken up and reaëration permitted to proceed. In artificial canals turbulence is avoided as largely as possible. The effect of a single dam upon deaërated water has already been shown to be equivalent to a large increase in initial dilution. Where dilution is for any reason limited, the capacity of sluggish and non-turbulent streams can be greatly augmented by providing an artificial turbulence at certain points in their course. Such turbulence need not be of the character of a fall, nor need it cause a serious loss of head. A number of mere overturns or "boils" will be found more efficient than a single large fall.

The determination of the reaëration coefficient of a stream has been undertaken for the first time in connection with the investigation of the Ohio River now being made by the U. S. Public Health Service under the direction of P. A. Surgeon Wade H. Frost. The actual analytical problem is exceedingly complex and the mathematical reduction and analysis of the results is both complicated and laborious. The work has progressed to a point at which it is indicated that results of value, consistent with the theory here stated, have been obtained.

Integral Waterproofing Compounds Favored

By far the greater number of the 2628 replies received as a result of a mail canvass of 10,000 architects and engineers, recently reported by *Structural Conservation*, are in favor of the use of integral waterproofing compounds. In answer to the question, "Do you favor the use of integral waterproofing compounds in concrete subjected to hydrostatic pressure?" 2025, or 94.2 per cent, replied in the affirmative and 126 in the negative. To the question, "Has your practical experience indicated that in cases where the integral waterproofing compound was not used, the concrete was absorbent and permeable?" 1809, or 92.7 per cent, replied in the affirmative and 142 in the negative. Similarly, to the question, "Have you observed that the use of an integral waterproofing compound was beneficial in correcting absorption and the porosity of the concrete?" 1602, or 91.8 per cent, replied in the affirmative and 142 in the negative. In a number of cases, as the returns indicate, all questions were not answered, which accounts for the disparity in totals.

Viaduct 170 Feet High Erected Without Falsework by Special Steel Struts

Deck Truss Spans 102 Feet Long Supported Temporarily at Center and Built as Cantilevers to a Bearing on Next Tower

AVOIDING the use of expensive falsework by designing special steel struts to be used in connection with guy cables and supported half way up on the towers, rapid and economical erection of a steel viaduct 170 ft. high at the center and 680 ft. long was accomplished with a light timber derrick having a 60-ft. steel boom. By supporting the center panel point of the main steel truss spans 102 ft. long and erecting the overhanging half as a cantilever, the trusses were built out to a bearing on the next tower partly erected to receive them. The tower was then completed and the traveler advanced to erect the next strut and the 102-ft. span.

The viaduct was constructed for the transportation of coal-mine cars across the inaccessible valley of Pinnacle Creek in Wyoming County, West Virginia, for the United Pocahontas Coal Company. All the members for the viaduct had to be transported on mine cars about 1 mile through the old drift of the Zenith Coal Company, which was extended northward to the face of the mountain. Thence the cars were to be carried over the new viaduct crossing to the coal fields recently acquired by the company.

TIMBER TRAVELER WITH 60-FOOT STEEL BOOM ERECTING TRUSSES

LIMITING CONDITIONS

As all material, including the erection equipment, had to be transported to the site through the Zenith mine, it was decided to use a light timber traveler for the erection. This necessitated the erection of the trusses piece by piece, which would normally require the usual falsework. To avoid this expense, inclined struts or booms were designed, with the lower ends pin-connected to temporary wing plates bolted to the columns of the main towers and the top ends held in position to receive the bottom chords of the truss span at midpoint by the use of 1¼-in. wire-rope cables, as indicated by the drawing herewith.

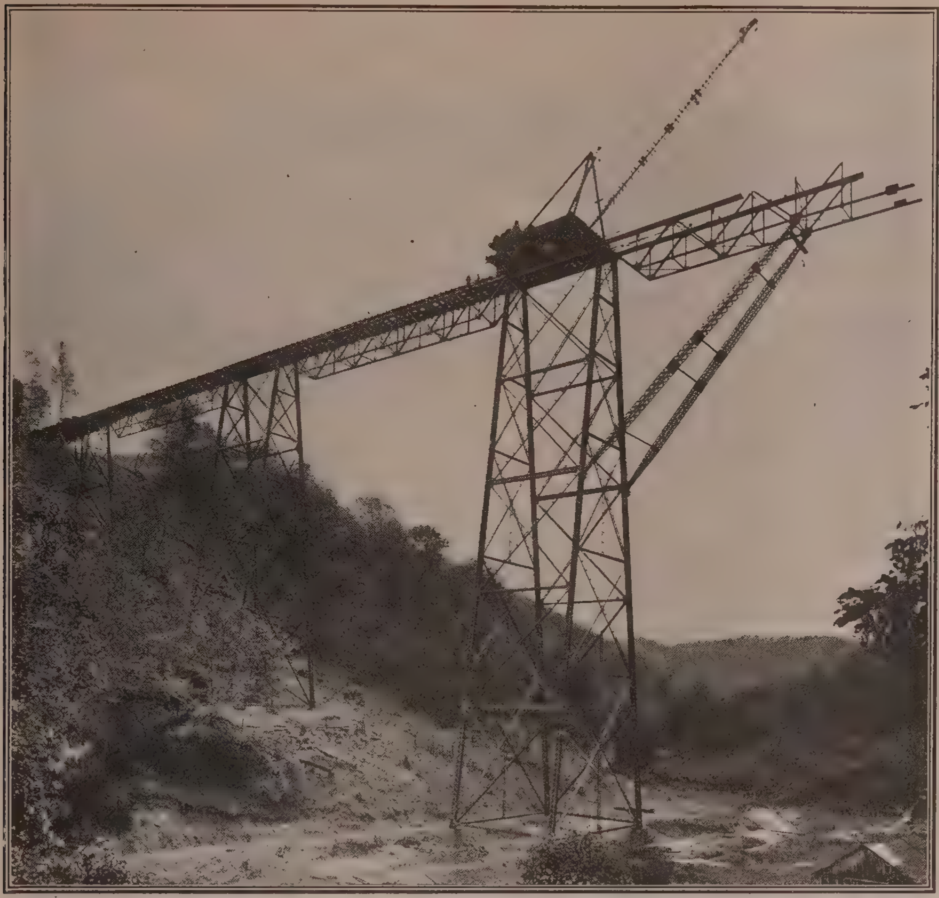
The original design for this viaduct provided 33-ft. towers and 70-ft. plate girder spans alternating, and one 175-ft. truss span at the center. This design was rejected on account of the excessive column loads at the ends of the truss span and the cost of the falsework necessary to erect such a span. The second design provided 37½-ft. and 75-ft. plate girder spans, alternating; but it was rejected because of the number of towers and the fact that two towers interfered with the right-of-way of a proposed railroad underneath the viaduct. The final design with the special erection scheme described is believed to be the best for the given conditions.

The assumed live load was an electric motor weighing 50,000 lb. distributed equally to two axles on 6-ft. centers, preceded and followed by a uniform load of 1000 lb. per linear foot beginning 6 ft. from each axle. Traction force was taken at 20 per cent of the motor load, and the impact was assumed at 50 per cent of the live load.

SCHEME OF ERECTION

A material yard was located along the Indian Ridge Track adjacent to the end of the bridge and the air plant set up. A total of nearly 20,000 rivets had to be driven. The traveler, of the gantry type, had a 60-ft. steel boom and side frames directly over the trusses, with the engine and working platform above. It was arranged so that the material could be delivered on push cars underneath the frame and carried forward to a position to be handled by the boom.

Beginning at one end, the first tower was erected, the plate girder spans set, and then the erection struts placed and guyed in position. The first truss span was built up to a point just beyond the center, the traveler moved forward to the center of the span and the next tower built up as indicated on the drawing. The remainder of the span was then built out as a cantilever,



THIRD TOWER COMPLETED AND 102-FOOT TRUSS BEING ERECTED

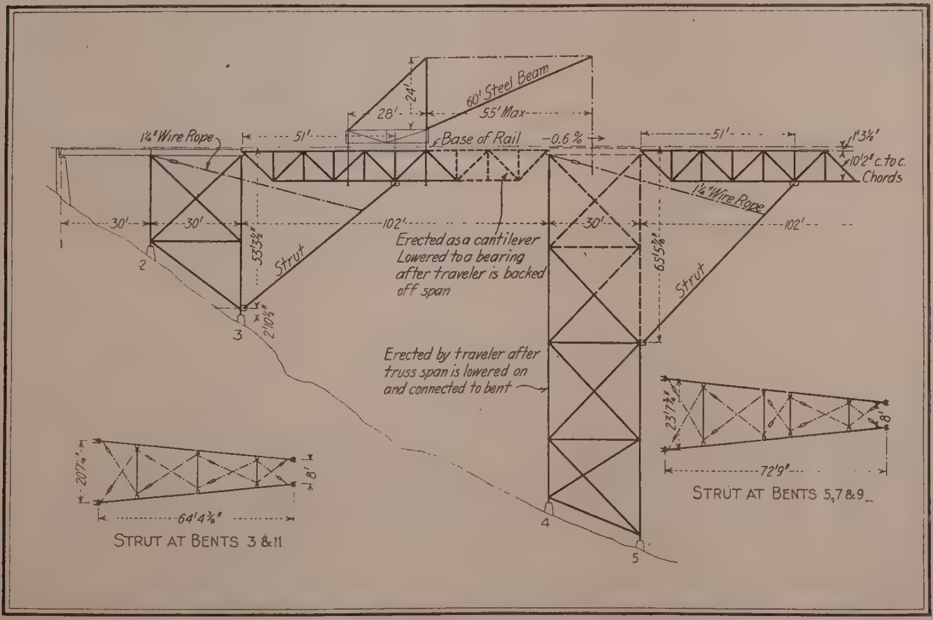
the traveler was backed off the span and the erection struts removed and transferred ahead to the next tower, which was completed, and the operations repeated for the whole length of the viaduct.

The struts were designed of proper length to give the desired camber in the truss spans, and no difficulty occurred in placing the last sections of the top chords. The scheme of erection worked out well, the entire viaduct, which weighed about 340 tons, being completed in 34 working days by an average force of 34 men.

The viaduct was designed by P. A. Blackwell, assistant chief engineer, and the scheme of erection was developed by H. S. Cowell, erection engineer of the Virginia Bridge & Iron Company of Roanoke, Va., which fabricated and erected the structure.

Plan Survey of Concrete Roads

The Portland Cement Association is planning to undertake in the near future a comprehensive survey of all concrete roads in the United States. Their condition will be determined and local authorities everywhere will be conferred with as to the maintenance such roads may need. It is intended to so record the findings of this survey that there will be in existence a real history of the concrete roads in the United States.



PART ELEVATION INDICATES SCHEME OF ERECTION—STRUTS BUILT UP AS SHOWN

Vitrified Pipe with Asphaltic Joints Used as Force Main

John B. Hawley Describes Results of Tests for Pressure Line in Texas Sewerage System

TESTS have demonstrated that 12-in. vitrified pipe, double strength, with asphaltic joint filler, is suitable for a sewage force main operating under a maximum internal pressure of 7½ lb. per square inch, according to a paper read at the recent convention of Texas engineers by John B. Hawley, consulting engineer of Fort Worth. This fact was developed in connection with the design of the new sewer system for Shreveport. The result was that vitrified pipe was used for the work instead of cast iron, at a considerable saving in cost. A summary of Mr. Hawley's observations and conclusions follows:

VITRIFIED PIPE TESTS

To determine the safety of the vitrified pipe, two lengths of double strength were put together. A strand of jute was tightly calked into the joint, so as to leave a 1½-in. depth for asphalt. A mixture of 58 penetration Texaco asphalt and lime dust, in proportion of 1 lb. of asphalt to 1¼ lb. of lime dust, incorporated at 300 deg. Fahr., was poured flush-full. Prior to calking in the jute, the inside of the bell and the outside of the spigot ends were painted with a thin coat of the same asphalt dissolved in gasoline.

Tight "round heads," with gaskets, were applied at the ends and through-bolted with three 5/16-in. steel bolts. An accurate pressure gage was attached to one head and a water connection made from a nearby tap. Upon application of pressure, very gradually, the joint showed signs of slowly pushing out, and at the end of about an hour, at 32 lb., one of the pipes, which had sweated considerably, failed. The joint had only oozed slightly at time of failure.

Another pipe was substituted, and a new joint mixture—1 lb., 35 penetration, to 1¼ lb. lime dust—was used, with paint coat and jute as before. Pressure was gradually applied, and at 40 lb. two of the 5/16-in. through bolts failed at the thread shoulder, stopping the test. Both pipes were intact and the joint held firmly, without any observable ooze.

SPECIFICATIONS

After this experiment, double-strength vitrified pipe was adopted for the lower end of the outfall, and specifications were written for joints as follows:

"All adjustment to line and grade, of pipes laid directly upon the bottom, must be done by scraping away, or filling in the earth under the body of the pipe, and not by blocking or wedging up. Before laying the interior of the bell shall be carefully wiped smooth and clean, and the annular space shall be kept free from dirt, stones or water. A gasket of dry Eagle packing shall be calked into each joint sufficiently tight to prevent the least intrusion of asphalt into the pipe. Such gasket shall be in one or more pieces, if the engineer so direct; shall be of ample length to reach entirely around the pipe, and of a thickness to bring the bottoms of the two pipes to the same level. No joint shall be poured until the gaskets of at least the two next joints in advance are properly inserted.

"All joints in vitrified pipe shall be asphalted. The mixture shall be composed of any standard refined asphalt 99 per cent soluble in CS_2, penetration 35 to 40, and sufficient cement mill lime dust or Portland cement incorporated hot, to a homogeneous mass of specific gravity 1.60.

"Before lowering into trench, the inside of the bell and outside of spigot of each pipe shall be well treated to a substantial 'naphtha coat' made by cutting asphalt above described with gasoline. Bell and spigot surfaces shall be 'bone dry' when the naphtha coat is applied.

"Fiber jointer, greased against adhesion of asphaltic joint material, shall be used in making joints. All asphaltic joint work must be done under conditions of perfect dryness of joints. The engineer will order underdrains, if needed to secure dryness, which will be paid for according to prices bid by contractor."

Mr. Hawley is fully convinced that double-strength 12-in. vitrified pipe is perfectly safe for the service mentioned, provided, of course, that each length is sound in body, bell and spigot. It further seems certain that asphaltic joint filler compounded as above, and hot poured onto asphalt painted surfaces, is wholly dependable. Its cost is said to be about 25 per cent that of asphaltic material sold under various trade names.

DRYNESS ESSENTIAL

It will be noted that the specifications provide for underdrains (to be paid for by the city) if necessary, to insure perfect dryness during the pouring of hot asphaltic joints. Such dry conditions, with proper asphaltic filler, paint coat and careful workmanship, will, Mr. Hawley believes, result in sewer mains and laterals of nearly perfect tightness against leakage from within and infiltration from without. It is within the possibilities, he states, that further study of rational methods of compounding and making asphaltic joints in vitrified pipes may result in the utter abandonment of cement-mortar joints, with their inevitable leakage. Nevertheless, a molten asphalt, at 300 deg. Fahr. or at any temperature above 212 deg. will not make a sound joint in the presence of moisture, as steam will surely be generated, causing porosity, poor contact, and even blowouts.

LINES AND GRADES

A few more paragraphs from the Shreveport specifications are quoted, as follows: "Pipes and specials shall be so laid in the trench that after the sewer is completed the interior surface thereof shall conform accurately to the grades and alignment fixed and given by the engineer. Limits of error will be allowed as follows:

"*Alignment*—All pipe of whatever size shall be laid within 0.1 ft. of true line, in any 50-ft. station.

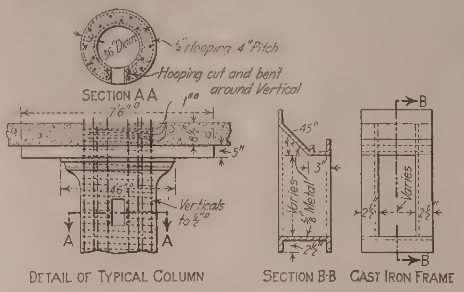
"*Grade*—On grades of 5 ft. per 1000, or greater, an error of 0.62 ft. at any point will be allowed. On grades of 3 to 4.99 ft. per 1000 an error of 0.015 ft. at any point will be allowed. On grades of less than 3 ft. per 1000 an error of 0.01 ft. at any point will be allowed." While first-class sewer construction is to be insisted on, Mr. Hawley explains, this clause is to inform the contractor that sewer building necessities and standards are contemplated, and not those of watchmaking.

The words "true line and grade," according to Mr. Hawley, are so frequently used by enthusiastic, academic, young, inexperienced and sometimes malicious engineers, to the utter defeat of common sense and ordinary justice in the administration of sewerage construction, that these paragraphs were deemed of economic value, as the "consumer pays the freight" eventually, even, as Mr. Hawley puts it, on engineering asininities.

Hollow Reinforced-Concrete Columns for Ford Plant

New Extensions to Detroit Factory Ventilated by Complete System Using Columns as Ducts from Fan Rooms on Roof

HOLLOW COLUMNS reinforced with vertical bars stayed by two spirals, with cast-iron outlets at each floor just below the ceiling, were adopted for the interior columns in the two extensions (29 and 30) for the Ford Motor Company's plant at Detroit. In spite of the special type of these interior columns, and the relatively difficult details at the crane-runway girder connections to columns and steel monitor framing over the craneway here shown, record speed was made in the construction of these buildings, as described in the Engineering Record of Oct. 7, page 430. The hollow reinforced-concrete columns here described should be compared with the cast-iron hollow columns used for the same purpose in the Victor Building at Camden, N. J. (see Engineering Record of Nov. 27, 1915, page 656).



TYPICAL DETAIL OF COLUMN REINFORCEMENT AT DUCT OPENINGS

The new Ford Building, 864 x 162 ft. in plan, with 20-ft. square panels, consists practically of two reinforced-concrete structures 62 ft. wide separated by a craneway 38 ft. wide, with a steel-frame monitor and skylight. In the design of the floors the usual flat-slab or mushroom type with four-way reinforcement was used, the typical slab being 8½ in. thick, with drop panels 7½ ft. square over the columns. The steel at the top of the slabs near the columns is bent around the openings for the vertical ducts, and three rings are inserted to reinforce the concrete in compression. Spandrel beams on all outside edges of the slabs carry loads to the rectangular exterior columns.

HOLLOW COLUMNS FOR VENTILATION SYSTEM

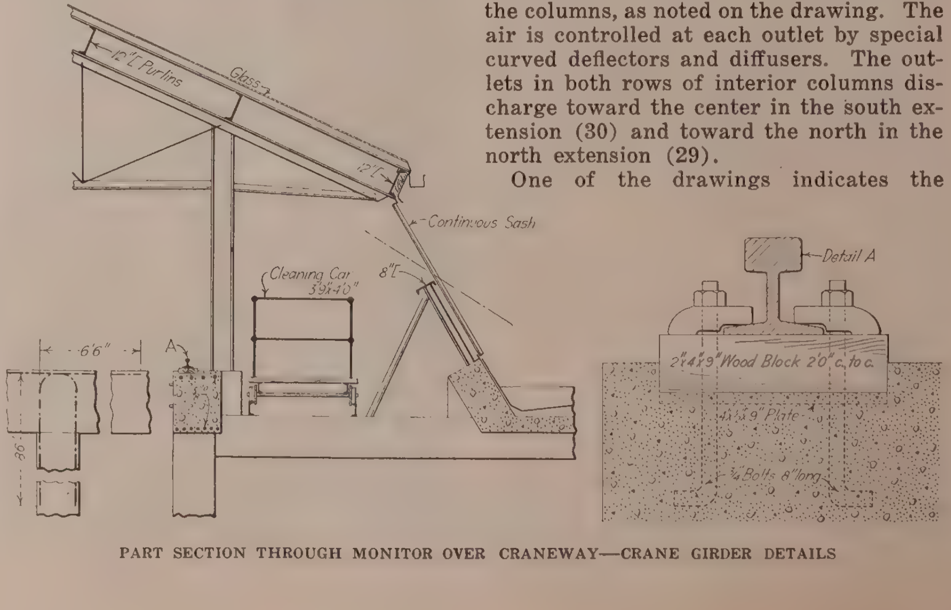
One of the most distinctive features of the design is seen in the use of reinforced-concrete hollow columns with vertical rods and spiral reinforcement near the inside and outside surface of the concrete ring. Sheet metal forms were used, the inside tubes remaining permanently in place, forming the air ducts leading from the fans on the roof to the cast-iron outlets embedded in the sides of the concrete columns below the floor level. As illustrated by the detail at a column head shown on the accompanying drawing, these typical interior columns are 36 in. in outside diameter and 18 in. in inside diameter for the lower section, decreasing to 35 in. outside and 22 in. inside at the top.

The air of the ventilating system is forced down through the columns, after passing through air washers, by fans in the eight fan rooms located symmetrically in pent houses on the roof. Each fan unit consists of a Sirocco fan and air washer having a normal capacity of 68,500 cu. ft. of air per minute. The air is heated by hot water at 155 deg. circulating through 100,000 sq. ft. of cast-iron Vento heaters. The system is designed to deliver 55 per cent of the total air supply to the first floor, 15 per cent to the second, and 7½ per cent to each of the third, fourth, fifth and sixth floors, from which it is drawn up through the craneway to the recirculating inlet.

CAST-IRON OUTLETS

The outlets consist of rectangular cast-iron collars flanged on the inner and outer ends, detailed as shown in one of the drawings. The hooping is cut at these outlets and bent back around the vertical rods in the columns, as noted on the drawing. The air is controlled at each outlet by special curved deflectors and diffusers. The outlets in both rows of interior columns discharge toward the center in the south extension (30) and toward the north in the north extension (29).

One of the drawings indicates the



PART SECTION THROUGH MONITOR OVER CRANEWAY—CRANE GIRDER DETAILS method used for reinforcing the 5-ton crane-runway girders of reinforced concrete and connecting them to the columns to insure continuity. The rails are supported on wooden blocks embedded in the concrete and are secured by the clips shown in the large-scale detail. Ample light from above is provided by the glazed roof of the monitor over the runway and continuous sloping sash on the aisle, as indicated by the part section.

The engineering and mechanical features of the building were designed by Albert Kahn, architect, of Detroit. The construction was carried out under the supervision of the architect by the George A. Fuller Company, of New York City.

Standard Forms Prepared for Traffic-Count Data

BASED upon information gathered from all the principal cities, standard forms for traffic counts have been prepared by a committee of the American Society of Municipal Improvements. This body consists of James C. Hallock, chairman, A. P. Folwell and Harland Bartholomew. In the accompanying diagrams the standard forms are shown. They are claimed to be simple, economical and complete and will facilitate equitable comparisons between counts in various cities.

Commenting upon the committee's work, Mr. Bartholomew points out that the increasing problems of traffic regulation necessitate constant study of the character and movement of traffic on all city streets. Systematic records of the character and volume of traffic will greatly assist in improving rules for traffic regulation; in determining the method and means of street cleaning, street planning, etc. For these reasons a uniform method of making traffic counts in all cities will greatly facilitate comparisons between conditions in various parts of one city or between various conditions in different cities.

Begin Studies to Find Cause of Concrete-Road Cracks

Periodic Measurements to Be Made of Vertical Movement of Pavement Slabs at Kenilworth, Ill.

By WILLIAM M. KINNEY
Assoc. M. Am. Soc. C. E., Chicago

REALIZING the need of a more thorough and scientific study of the cause of cracks in concrete pavements, an experiment to obtain data regarding the vertical movement of pavement slabs is being conducted by the Promotion Bureau of the Universal Portland Cement Company on a pavement constructed this year on Sheridan Road, Kenilworth, Ill., extending from the northern limits of Wilmette to the southern limits of Winnetka. This experimental study is being carried on in a manner somewhat similar to that suggested by S. Whinery in his article in the Engineering Record of Oct. 28, page 529, under the title "Tests Needed to Verify Concrete-Road Cracking Theory." It is a coincidence that these tests should have been started at practically the same time as the above-mentioned article appeared; in fact the first readings were taken Oct. 27.

The experiment consists in determining the elevation at various seasons of the year, particularly when the frost is entering and leaving the ground, of points on the center line and near the curb in each slab. The ends of the slabs being protected by steel plates firmly anchored into the concrete, it was not considered necessary to set plugs in the pavement. A ¼-in. hole was drilled in the top of each plate at the center line of the road and at a distance of 4 ft. from the back of each curb, giving six points at each joint on which readings are taken, three on each joint plate. There is a total of 87 joints in the concrete pavement under test, thus making 522 readings. The majority of the joints are placed from 30 to 36 ft. apart, while the spacing of several of them is upward of 50 ft. Five benchmarks were established from which precise levels were taken in accordance with methods employed by the United States Coast and Geodetic Survey. Prof. William H. Burger of Northwestern University, Evanston, Ill., took the readings.

It is planned in addition to the readings already taken to take readings from the same points directly after the frost enters the ground and once every month thereafter until next spring, when readings will be taken more frequently to determine, if possible, the exact movement of the slabs as the frost leaves the ground. An accurate survey of the surface will also be kept in order to note if there are any signs of cracking.

CHARACTER OF PAVEMENT

The pavement under test is a 40-ft. concrete pavement with integral curb. Two-course construction was used, with a thickness at the sides of 7 in. and at the center of 10 in. The concrete for the base consisted of a mixture of 1 part cement, 2½ parts sand and 4 parts pebbles. The concrete for the top wearing surface consisted of 1 part cement, 1 part sand and 1½ parts of ¼ to ½-in. granite.

It is hoped, by making a careful and accurate survey of this road, to determine whether frost action is responsible for the longitudinal cracking of concrete pavements. Many engineers are of the opinion that this cracking is caused in many instances by the action of the frost entering and leaving the soil under the edges of the slabs, first causing a movement through the expansion of the soil and later settlement due to subsequent contraction. This experiment should throw considerable light on this subject.

______ DEPARTMENT CITY OF ______	Traffic Census Observation Report	Direction ______ On ______ St. or Ave. Between ______ St. or Ave. And ______ St. or Ave.
Date ______	Weather ______	Observer ______
Pavement ______	Condition Clean / Dirty ______ Damp / Dry ______ Slippery / Safe	

				8to9	9to10	10to11	11to12	12to1	1to2	2to3	3to4	4to5	5to6	6to7		
IRON TIRES	1 Horse Vehicle	Light														
		Heavy														
	2 Horse Vehicle	Light														
		Heavy														
	3 or More Horse Vehicle															
	Total															
Street Cars																
RUBBER TIRES	Motorcycles (or Bicycle)															
	Passenger	2 Pass														
		3 or More														
	Freight	Large	Loaded													
			Empty													
		Small	Loaded													
			Empty													
	Total															
Grand Total																

On ______ St. or Ave. Between ______ St. or Ave. And ______ St. or Ave.

Date	Kind of Pavmt.	Date Laid	Width of Road	Wet or Dry	No of Hours	Vehicle Data										Tonnage Data							
						Total Per Day			Average Per Hour			Maximum Hour		Average Per Minute Per Foot—Width Of Pavement		Total Per Day	Average Per Vehicle	Average Per Min. Per Foot Width of Road	Total Per Year Per Foot Width of Road	Percent of Traffic		No. of Street Cars	Traffic Units Per. Min. Per Foot Width of Road
						Horse	Motor	Total	Horse	Motor	Total	Number	Hour	Travelled Width	Total Width					Horse	Motor		

THESE STANDARD FIELD AND OFFICE FORMS RECOMMENDED FOR TRAFFIC COUNTS ARE CLAIMED TO BE SIMPLE, ECONOMICAL AND COMPLETE

Coal Tar Helps Maintenance of Metal Flumes

Reclamation Engineer on Uncompagre Project Experiments with Seven Coatings—Life May Be Doubled If Properly Applied

EXPERIMENTS with various paints to preserve metal flumes carried on by engineers of the U. S. Reclamation Service indicate that coal tar and its compounds give the best results. Fred D. Pyle, project manager, Uncompagre Valley Project, on Sept. 19 outlined the tests to the conference of project managers at Denver. His paper appears in the November *Reclamation Record.* The metallic portion of flumes on timber superstructures supported on concrete piers costs 25 to 30 per cent of the total cost. The concrete portion is permanent except when it comes in contact with shale; the woodwork is good for twenty years at least, and by replacing individual pieces is good for twenty-five years. Indications are that unprotected galvanized steel flumes will have a life of ten or twelve years, except under the most trying conditions, namely, high velocity of water carrying sand and fine gravel, where the life in one particular instance was only four seasons' use.

PAINTS NOT SUFFICIENTLY TESTED

Tests of various kinds of paints and other protective coatings have not been carried on for a sufficient period to give definite results, but it appears that the life of the metal may be doubled by their use. Galvanized steel has been employed in all cases, except for a small quantity of ungalvanized steel and Keystone metal placed for experimental purposes.

The principal difficulties met in operating metallic flumes are of two classes—those due to accidents and those due to wear. In the first class can be counted settlement of approaches and of foundations; buckling or pulling apart of flumes resulting from inadequate expansion joints; washouts caused by floods in drainage channels crossed, or as a result of breaks in canals at the ends of flumes. In the second class can be included deterioration of the flume due to action of water, sand and atmosphere. The erosive action of sand or grit carried at velocities over 3 ft. per second is very pronounced, especially in the flumes having rough interior joints, first removing the galvanizing, thus exposing the steel to both rust and erosion, so that it is soon pitted and in extreme cases can readily be punctured with a lead pencil.

If galvanizing is not of the best quality it may allow the rusting of the underlying metal with the characteristic pitting, which in time destroys the usefulness of the flume. The pitting in some cases commences during the first season's use. The progress of the pitting is slow, however, unless there is sufficient sand in the water to scour off the rust. The pitting and rusting often occur in the joints. Ordinarily the rusting in the joints may be the most dangerous on account of being the most difficult to detect. The action of the atmosphere is almost negligible and may be disregarded, and for this reason the outside of the flumes need not be painted.

EXPERIMENT WITH SEVEN PAINTS

On March 23 a newly completed No. 60 galvanized steel flume was painted with seven paint and tar mixtures as an experiment to determine the relative permanence of each mixture. Seven 36-in. sheets were painted with each mixture, three unpainted sheets being left between some of the sets for observing the condition of the galvanizing.

On Sept. 15 Mr. Pyle made an examination of the flumes and found the following conditions:

African Black—Traces left in bottom, none at water line; slight traces above water line. Became lifeless and flaked off; rubbed off in powder. Paint on east side of flume in worse condition.

Egyptian Black—Same condition as African black, except a little more paint was left on the metal.

Elastic Graphite—In fair condition both above and below water line; also at water line. Lacks body; dry. May or may not be good for another season.

Green Graphite—Peeled at water line; dry and flaking off below; fair condition above.

Tar Compound—In good condition; undoubtedly good for another year; not affected by water; less body than coal tar.

Coal Tar—Excellent condition; good body; not affected at water line; tacky.

Green Paint—Peeled at and above water surface; checked and lifeless below water, with considerable flaking off.

Unpainted Sections—Showed pitting and loss of galvanizing on 10 per cent of the area below water line.

From the foregoing it will be observed that the coal tar, coal-tar compound and elastic graphite were the only mixtures that could stand one season's use, and there was some doubt as to the elastic graphite standing another season.

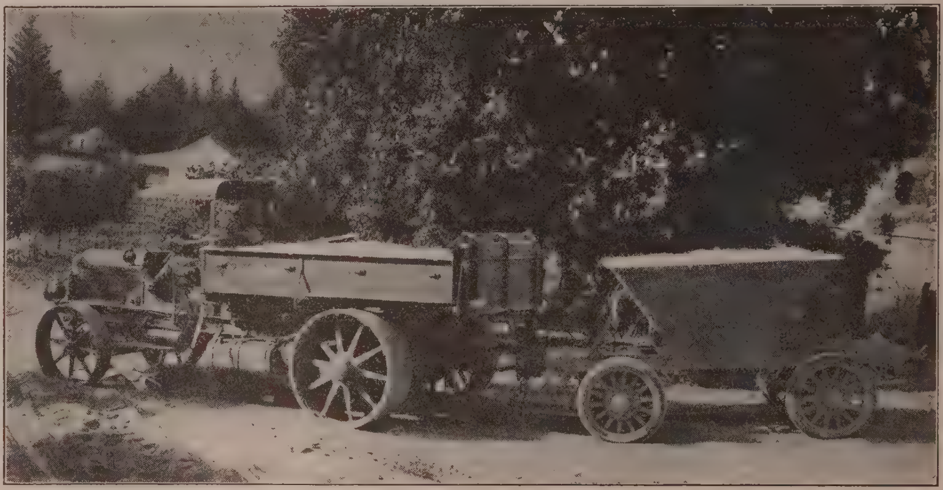
Discover Uses for Bark of Trees

The U. S. Forest Products Laboratory at Madison, Wis., has found a way to use even the bark of trees. By a new process waste bark can partly replace expensive rag stock in the manufacture of felt roofing. It is already being used commercially by mills co-operating with the laboratory experts. The bark thus used is that remaining after the extraction of the tannin for leather work. The same waste bark has been used successfully for making wallpaper. Experiments now in progress indicate that the hemlock bark may be used for sheathing paper, carpet lining, bottle wrappers and deadening felt.

Truck with Steel Tires Solves Difficult Haulage Problem

Halves Cost of Transporting Stone Over Mountain Road, Covered Deep with Dust, That Baffled Teams and Motor Truck

AFTER experimenting with both horse-drawn and rubber-tired vehicles, the A. A. Haskins Dolomite Company of San Francisco, California, owner of the largest pure dolomite quarry in the United States, has cut down the cost of transporting 40 tons of stone daily 10½ miles to the railroad from $58.21 to $28.71 by using a White Good Roads truck and 5-ton trailer. The truck operates 24 hours a day over a crooked mountain road covered for four-fifths of its length with fine dust 6 in. deep. To load a car of material a day with horses required five 8-horse teams, and the cost of $1.45½ per ton is stated to have been prohibitive.



STEEL-TIRED TRUCK SOLVES HAULAGE PROBLEM ON ROUGH MOUNTAIN ROADS DEEP IN DUST

The quarry is located in San Benito County, and the road from it to the railroad is one of the worst in the country. On the 8-mile stretch mentioned there are grades of 8 and 10 per cent, ranging in length up to 1½ miles, in which are many sharp turns. The last quarter of a mile of the road is across the deep sand and gravel bed of the Salinas River, which is always dry in summer. In order to give the truck better traction, this section has been packed with straw.

After it was found that the cost of transportation by means of horses was too great, a rubber-tired truck was purchased. This truck was not able to operate efficiently on the rough roads. The steel-tired truck finally solved the problem.

The truck and trailer are loaded direct from a chute at the quarry in about three minutes. To reach it, the truck climbs a 10-per cent grade in 12 in. of dust. As tonnage and dependability are more essential than speed, the drivers are not allowed to exceed 5 miles an hour. There are two shifts of drivers and the truck uses 44 gal. of gasoline and 4 gal. of oil a day to haul 40 tons, traveling a total distance of 84 miles. As the summer days are extremely hot and the nights cool, 12 gal. of gasoline per round trip are consumed in the day time and 10 gal. at night. On the basis of daily saving of $29.50 as compared with the cost of team haulage, the truck paid for itself in the first seven months of operation.

Highway Conditions in Pioneer Good-Roads State Unsatisfactory

New Jersey, After Spending $100,000,000, Has Inadequate System, Inefficiently Administered—Good Arguments Advanced Against Bond Issues

BEFORE the advent of the automobile New Jersey held first rank among the states in the matter of good roads. To-day conditions are changed. With inadequate highway laws the various civil divisions have been unable to cope with the road distress caused by fast-moving motor vehicles.

Realizing the seriousness of the situation, the governor last spring appointed a commission to make a study of the road problem in all its aspects and to report to him on ways and means of relief and of putting the highway work of the state on a sound basis. Simultaneously the New Jersey State Chamber of Commerce began a survey of road legislation, administration and needs, co-operating with the commission appointed by the governor. The work of the chamber is now completed and the results have appeared in a report over the signature of Harry Meixell, Jr., assistant secretary of the chamber's Bureau of State Research.

Scope of Report

The report reviews, first, the expenditures already made on New Jersey roads, pointing out that on the improved roads alone not less than $100,000,000 have been spent in 25 years. Jurisdiction, when studied, is shown to be divided between 500 different administrative units, which on account of inadequate laws do not co-ordinate their efforts.

The highway needs of the state and the principles on which a sound road policy must be based are then studied. It is concluded that an adequate state system must include 1500 miles of road, to construct which to proper standards would require the expenditure of $30,000,000. The financing of this expenditure forms the final chapter of the report. A strong argument is made against highway building through bond issues.

The following extracts give the meat of the main divisions of Mr. Meixell's report:

Expenditures

According to estimates prepared by the State Chamber of Commerce, the location, construction, reconstruction, resurfacing, repairs, maintenance, financing and administration of New Jersey's 9,147.56 miles of improved roads have cost at least $100,000,000 during the past 25 years. The figures are stupendous, yet very conservative. Indeed, Bulletin 386 of the U. S. Department of Agriculture estimates that New Jersey's improved roads have cost us $140,000,000. These figures represent expenditures for a period during most of which the units of traffic were comparatively few and light. Now traffic units are increasing in number, speed, size, and road destructibility daily, and these units no longer circulate locally, but throughout the entire state.

Last fiscal year alone—exclusive of expenditures by towns, cities, townships, boroughs and villages—the state and counties of New Jersey are estimated to have spent over $4,000,000 for work on improved roads. In 1914 the expenditures by the state and its civil divisions are estimated to have been $7,208,287 for improved roads. This year the figures will mount even higher. Individual counties are bonding themselves for as high as one-half million dollars for highway expenditures, the state is giving them many thousands more for aid in construction, reconstruction and so-called repairs, and the smaller governmental units of these counties are raising thousands more to be spent for the same purposes. At this rate, if present methods prevail, the next 25 years will see every penny of $200,000,000 spent on New Jersey's improved highways.

It is impossible to tell how much money has been expended upon the 6,123.24 miles of graded roads in the state. In like manner, no financial data are available for the 5,174.69 miles of unimproved roads.

Jurisdiction and Control

There are 21 counties in New Jersey, 235 townships, 180 boroughs, 4 villages, 24 towns, and 43 cities.

In each one of these governmental divisions is some sort or other of a road organization. The personnel of these organizations, as a rule, is untrained, inefficient, and indifferent. Standard and coordinated effort in road matters between county, township, borough or other municipality is impossible. There are numerous instances where on a single 5-mile stretch of road three or four different types of jurisdiction and control have exclusive authority over portions of that road. They construct these portions when and as they see fit, they maintain them or not as they choose and when they choose, and apply ready-made systems of financing and administration.

The selection of road routes, the choice of materials; the awarding of contracts, the inspection and certification of the job; the acceptance of the completed work, the raising of the funds to pay for it, the subsequent maintenance and administration of the roads; these important matters and many more, all of which, particularly at the present time, require the intelligent consideration of highly trained experts, are left to the care of seven different types of governmental authority, which in turn delegate this authority to over 500 diversified units of these various types of government. The numerous diversified units in their turn pass these vital road powers, duties and responsibilities onto the local politicians.

Old Road Laws Vague

This jurisdiction and control scattered among the civil divisions of the state is based upon a great conglomerate mass of road legislation composed of numerous original acts which have been greatly aggravated and complicated by subsequent amendments, supplements and revisions. The provisions of these road laws are often vague and indefinite, frequently too narrow or restrictive in scope, and more often conflicting in their own paragraphs or with the paragraphs of other acts. Most of them were framed to meet the conditions obtaining before the advent of the automobile.

In a new system there must be, first of all, an intelligent selection of the routes for the highway system. With a road mileage of over 20,445.44, or an average of 2.72 of a mile of road for every square mile of area, it is obvious that for some time to come there will be very little necessity of acquiring new rights-of-way for the improvement of the roads that will enter into our system. Additional property may be necessary for widening certain roads, for avoiding bad grades, eliminating sharp turns or for shortening distances, but the chief difficulty will be the proper selection of routes from a number of possibilities. This will be particularly true in the choice of routes for the main arteries of travel which must be the foundation so to speak for the entire road system.

State-Wide Traffic Census Undesirable

Some persons advocate a state-wide traffic census, taken at different intervals and at different seasons of the year on all the roads throughout the state, and then selection by this method of roads which show the heaviest traffic. Such a procedure is open, however, to very serious objections. Given roads No. 1, No. 2, No. 3 and No. 4, it may so happen that the condition of road No. 1 during the course of the year is so much better than that of the other roads that traffic will go several miles out of the way and use up considerable time in order to travel on this particular highway. A mere traffic count would seem to indicate road No. 1 as the logical one for a main artery of travel. Road No. 2 may be shorter, road No. 3 may tap a more prosperous and more thickly populated district, road No. 4 may be in reality the ideal road for a highway artery. The poor condition of road No. 4 has discouraged traffic, and the traffic count apparently proves it of less importance for a main artery than No. 1. How can a proper selection therefore be made?

A road, as has been said before, is primarily the physical expression of the transportation needs of the community. It is evident therefore that these needs, so far as they are general and state-wide, should receive careful consideration when planning the selection of routes for the state highway system and particularly for the main arteries of travel. What are the economic factors in the state which now or in the future will give rise to state-wide or even nation-wide road transportation? Where are the sources or destinations of actual or potential state-wide traffic? What is or will be the character of this traffic? Must the freight have direct and rapid transportation, as is the case with perishable farm and other food products, or will it admit of longer and more indirect routes? These and many other similar questions must be answered in seeking ideal locations for the routes of our state highway system.

Must Serve General Needs

It is vitally important that in this system the great arteries of travel be selected with all due regard to the transportation needs of the entire state. Individual counties, individual divisions within the county, must lay aside their purely selfish or sectional interests and co-operate in the effort to locate these main trunk-line roads along the routes which will bring the greatest economic benefit to the whole state.

The same intelligent selection of routes must be made in choosing for development and improvement feeder roads to the main arteries of travel. The importunities of some particular township, borough or village, or its political influences, must not be allowed to hinder the economic development of any community where that development is directly dependent upon the proper selection and improvement of feeder roads to the great arteries of travel.

As for the branches of the feeders, here again the only justification of their existence as public roads and of expenditures upon them, and the only order in which they should be selected for improvement, is their relative importance in serving the transportation needs of the country they penetrate. To locate any single unit of the state highway system where it will not in a thorough and economical way accommodate the actual and potential traffic along its route, or to place any such unit where it will not co-ordinate perfectly at all times with the rest of the system, is to ruin the effectiveness of such a state highway system.

SURVEY

Our highways laid out and built to accommodate the local, light and slowly moving traffic of bygone days are inadequate for modern transportation conditions with heavy loads, high speeds and state-wide circulation. Steep grades, narrow pavements, deviation from a straight line and bad curves cause a heavy wastage of time, increased wear and tear on vehicles, and added consumption of motive power. Disregard of topography, climate and drainage have and are accelerating road disintegration. There must therefore be a road inventory, so that every element that directly or indirectly can have a bearing on the effectiveness, the economy and the safety of our system may be analyzed and amply provided for.

The relative cost, availability and durability of road building materials must be considered, as well as their suitability for climate, soil, drainage and other conditions existing in the parts of the state where they are to be laid down.

FINANCING

The greatest problem which must be confronted by the people of New Jersey in establishing and operating a high-grade comprehensive state highway system will be the financing of such a system. It will require a lot of money, and this is particularly true at the present time when the cost of materials and the wages of labor are at a very high level. The great danger will be that these conditions will either prompt the people to postpone the establishment of the system or to build up only a small portion of it, or perhaps to put down an inferior system, or to adopt precarious methods of financing the system. To adopt any one of these courses will be wasteful folly.

The economic development of the state demands that a highway system be put into working order within the next few years. Fairness to every portion of the state demands that the system be comprehensive and that it be available for every resource of the state which is worth developing. The outlook for the future demands that the roads of the system be constructed not merely with a view to sustaining actual present traffic, but the traffic of the next 15 or 20 years. Finally the future solvency of the state and its civil divisions, and ordinary decency, demand that we do not shift the burden of the cost of the system upon our children. We of to-day are paying the interest and principal of road bonds contracted for improvements whose usefulness has long since disappeared. Our financing from now on must proceed along more intelligent and scientific lines, and the state highway system is a good place for the state to begin and set the proper example on the main arteries of travel for its counties and other civil divisions to follow in their road affairs.

On a maximum estimate to take over 1500 miles of main arteries of travel during a period of five years and to bring this mileage up to the standard of the state highway system and maintain them in that condition will cost the State of New Jersey $30,900,000.

EXPENDITURES FOR NEXT FIVE YEARS

The computation for road funds derived from general appropriations, the motor-vehicle fund and federal aid during the next five years is $12,276,400. This presupposes that not a dollar of this money will be spent for state aid to counties or other civil divisions for construction and maintenance, and that every penny will be expended on the main arteries of travel only as they are taken over and brought up to standard by the state.

It is obvious that the state must make up by some method or other the balance of $18,623,600 if the proper basis of a comprehensive state highway system is to be established. A state-road tax is the only sensible solution to the problem. No doubt a cry for an issue of bonds to provide for this balance will be raised. But why a bond issue, with its burdensome interest and other carrying charges? Why a bond issue which in the last analysis must be financed like the road itself from true and actual receipts?

Yes! But the main arteries will be fairly permanent, and surely it is good finance to spread the great cost of their improvement over the number of years that we can be sure they will last.

That argument was advanced in justification for 30-year bond issues on macadam roads, laid down five years ago and later. We still have the bond issues; where are the roads? That same argument is justifying bond issues to-day for certain types of roads, which every sign of the times tells us will go to pieces long before the bonds mature.

MOTOR-VEHICLE TRANSPORTATION

We have not passed the threshold of motor-vehicle transportation in New Jersey. We are simply standing in the doorway. No one can foretell the strain which our main road arteries must bear within the next five or six years. No one can predict that a certain type of road will not need rebuilding within that period. Let us play safely and pay cash for our state highway system, spreading the cost over a five-year period of construction.

According to the 1915 report of the state comptroller the ratables of the State of New Jersey for the year ended Oct. 31, 1914, were $2,583,953,595.29. Between the five fiscal years 1917-1921 during which the state highway system will be constructed the ratables of the state will doubtless average three billion dollars or more. On this basis of three billion dollars of ratables over a five-year period it is evident that a road tax of 1 mill on the dollar would yield an average of $3,000,000 annually, or a total of $15,000,000 over a five-year period.

Here, then, are the means of obtaining $27,276,400 over a five-year period for the construction and maintenance of the 1500 miles of main arteries of travel of the state highway system. There would still be $3,623,600 necessary to meet fully the requirements. We could meet this problem by postponing the construction of 180 miles one year.

NO NEED FOR BOND ISSUE

At all events the plan obviates entirely the need for a bond issue, and a road tax of 1 mill on the dollar will hardly prove a burden to any taxpayer. But even if it should, 1 mill on the dollar is only $1 in the thousand, and what owner of property will not have the value of his property increased many times that amount by the establishment of a state highway system with high grade arteries of travel built, maintained and managed by the state?

Don't let any taxpayer who is partial to bond issues for financing these main arteries of travel forget that $1 at 4 per cent doubles itself in 25 years. Is it possible that he fails to see that if he authorizes bond issues for that length of time, he and his children will be obliged in the long run to pay direct taxes far in excess of those required for immediate cash payments? A bond is a debt, and, although many persons dealing with public affairs think otherwise, debts must be paid. Let us not therefore lightly incur a lot of burdensome bonds in establishing and financing the main arteries of the state highway system or indeed in establishing the feeders and branches of the system. The experiences of one of our neighbor states ought to warn us against such procedure in road matters.

MAIN ARTERIES FIRST

In the foregoing discussion it has been insisted that the expenditures of the state should be strictly limited to the main arteries of travel of the state highway system. This should be rigidly adhered to until all the main arteries of travel are brought up to standard. When the counties are entirely relieved of the financial burden of constructing, reconstructing, repairing and maintaining these main arteries, they will have large sums available for improving and maintaining first the feeders to the main arteries and lastly the branches to the feeders. Any surplus funds which the state might have after the construction of the 1500 miles of main arteries, or any annual balance that may be left after these main arteries have been properly maintained, might then be used for state aid on the feeder roads or perhaps be used for extending the mileage of main artery roads.

Bituminous Coat in Concrete Road Should Be Laid in Warm Weather

Experience with concrete street surfaces in Athens, Ga., reported by J. W. Barnett, city engineer, shows that the application of a bituminous coating (½ gal. of Tarvia to the square yard and coarse, sharp sand applied at once) gives most satisfactory results when the materials are all hot—that is, in warm summer weather, and when the concrete surface is roughened by a broom before it has set hard. If the materials are too cold, the coating peels off and leaves unsightly patches.

Queen & Crescent Has Carried Out Extensive Program to Improve Drainage of Roadbed

Cross-Drains and "Shooting" of Fills Stop Sliding—Borrowpits Were Drained and Water Was Diverted—Steam Ditchers Widened Cuts and Fills

By J. T. BOWSER
Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

THE Cincinnati Southern Railway, which is owned by the city of Cincinnati and is operated under lease by the Cincinnati, New Orleans & Texas Pacific Railway as a part of the Queen & Crescent Route, was constructed by the city of Cincinnati in the '70s. At the time of its construction it may be said to have represented the last word in construction methods as to grade and alignment and as to roadbed, considering the topography of the country traversed. The changed conditions which have come about since the construction through increased weight of equipment, the increased volume of traffic and the increased train speeds, together with the development of the science of railway engineering in recent years, seemed to require improvements in the way of drainage, cross-section of roadbed (which is so closely related to drainage) and other items involved in the economic maintenance of track.

Furthermore, considerable trouble had for many years been experienced with settling and sliding fills and with soft track on certain parts of the line, notably the 60-mile section between Ludlow and Rogers Gap, Ky. This trouble began to assume serious proportions when the heavier types of engines were put in use on this section of the line in 1912. It was at this time that serious attention began to be given these conditions with the view of permanently remedying the trouble, at least at the worst places.

Drainage Program

In order to bring about conditions that would permit the economic maintenance of track through this section a general program of work was adopted embodying not only the drainage of the wet fills and soft places but also the widening and strengthening of embankments, the widening of cuts and track ditches, the installation of subsurface tile drainage and the improvement of conditions in other ways, involving practically the reconstruction of the track at certain points.

While a certain amount of widening of cuts and embankments could be, and was, done immediately where no trouble had been experienced or was to be expected with soft track, it was obviously desirable that all subdrainage designed to eliminate soft spots and wet fills be effected before this drainage was done. In cuts where trouble was experienced with soft track, drain tile was laid at a depth averaging about 7 ft., the distance from the track varying with conditions, but in the main being about 10 ft. from the center of the track. This tile was very carefully laid as to grade and alignment, an excavation in the natural ground in the bottom of the trench being shaped to fit the pipe. Backfill over the tile was made with cinders, slag or other porous material.

Each sliding or settling fill was a problem in itself, and various methods were used to cure the trouble. In each case careful consideration was given the location of the fill, the material therein, the drainage of water toward and away from it, the presence of springs and seeps in the vicinity, the condition of existing culverts and the necessity of additional openings.

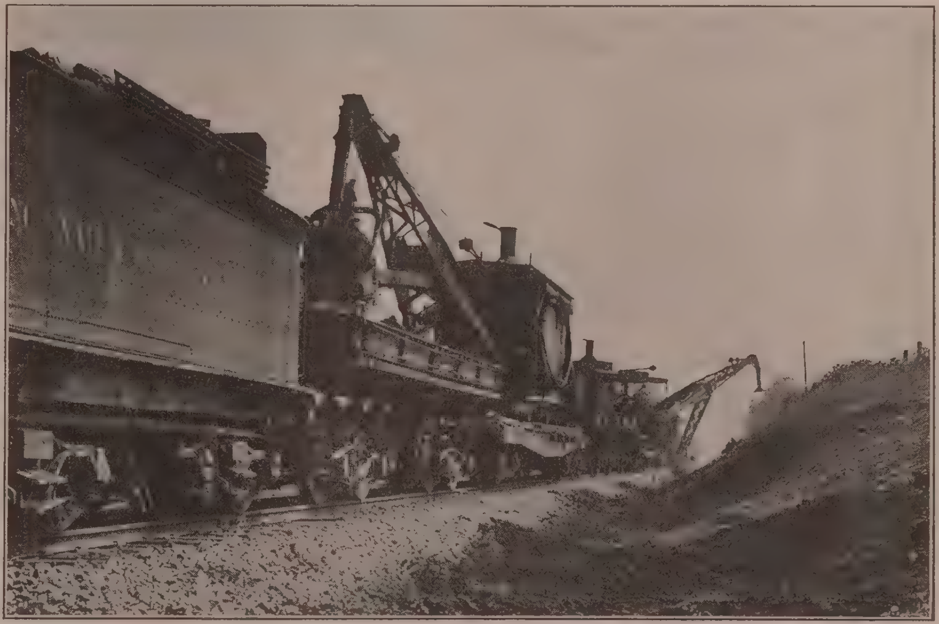
A number of these fills were located on more or less pronounced slopes, and the trouble in these cases was found to be due either to the slipping of the material in the fill on the top of the original ground surface or the slipping of the material underlying the fill on some inclined stratum. In either instance the presence of water was the immediate cause. On fills of this kind well drills were placed on the downhill side and holes were drilled in a line parallel to the track, across the sliding portion of the fill, into rock if this was found at a reasonable depth, or failing in this, into solid hardpan. These holes varied from 30 to 70 ft. in depth, and were located from 20 to 40 ft. from the center of the track, according to local conditions. These holes were then heavily shot with dynamite, the usual loading being about 250 lb. to the hole, although this of course varied to some extent with the depth of the hole. This shooting was usually effective in opening up seams in the underlying material, which disposed of the water, and in roughening the slope on which the sliding material had been moving, so that, no water being present, any further tendency to slip was checked.

On other fills, however, the trouble was found to be due to the presence of water pockets in the fills themselves. In such cases cross-trenches, at right angles to the track, were excavated to points well under the track, drain tile was laid in them and a backfill made of one-man stone. In many cases as many as five or six of these cross-drains were considered necessary, and since, owing to the looseness of the material in the fill, the trenches were quite wide, the rock backfill not only provided adequate drainage but also constituted a heavy reinforcement to the fill.

Drainage of Adjacent Ponds

Consideration was also given to the drainage of ponds adjacent to embankments, formed by old borrowpits or improperly placed culverts and the like, for even though they were located at some distance from the track they were often found to be acting as reservoirs which supplied the seepage that caused the slides or settlements. Additional culverts were put in where necessary, and where trouble had been experienced in keeping the ends of existing culverts open, due to the filling up of the space which they drained, well holes or catchbasins were constructed over the entrances to raise the level of the openings.

Berm ditches were excavated on the tops of cuts where erosion from the cut face was marked, and diversion ditches were cut wherever water could be turned away from the bases of fills or carried more directly to the culverts. At a number of points the wash of streams or large ditches adjacent to embankments made necessary rather extensive bank protection if the new wider standard for embankments was to be maintained. At such points riprap walls, and in several cases concrete walls, were constructed. Low dry-masonry walls were also constructed at bridge abutments or similar points where a full width of embankment could not otherwise be obtained without prohibitive expense.



TWO DITCHER OUTFITS WERE ORDINARILY USED WITH ONE WORK-TRAIN AND LOCOMOTIVE

Ditching by Work Train

As the work on drainage and preparation of subgrade progressed, the widening of cuts and embankments was carried on where such preparatory work had been completed or was unnecessary. This work was handled by American steam ditchers and by teams and scrapers, the dressing up after these outfits being done by hand.

The ditchers, three of which were in operation, were mounted on their own rails on special flat cars. The excavated material was placed on 16-yd. air-dump cars which were equipped with extension aprons designed to dump the material as far as possible from the track. One of these cars was located at each end of the flat car supporting the ditcher. The excavated material was dumped on adjacent embankments, and was spread down and roughly dressed by spreader cars, one of which was assigned to each outfit. The majority of the cuts thus widened were long enough to permit the operation of two ditcher outfits with only one locomotive, thus saving the expense of one work train. The unit cost of this work has been quite low, considering traffic conditions, as it varied from 5 to 15 cents per yard, including work-train costs and the cost of spreading. Practically all of this work was done from the main track, and much of it was in rock. Just here it may be said that a close check of the delays sustained by the work trains and the services of a good work-train conductor are of prime importance in keeping down the cost per yard.

Since the ditchers and spreaders could not make a finished job, a gang of laborers followed them and made the standard ditch, dressed the faces of the cuts and fills and made the finished shoulder.

Teams for Shallower Cuts

The work on the shallower cuts and higher fills was handled by teams and scrapers, as the ditchers do not work so economically on a low face, and as on the higher fills the addition is preferably built up from the bottom. In these cases the usual practice for the construction of new fills was followed, and a dressing gang finished up the work.

It was not found advisable to let this class of work by contract on the yardage basis, and it has therefore been handled on force account, the work being supervised by a representative of the railroad company, who also checked up the time.

Slopes Seeded

In finishing up all of this work the dressing was carefully done, and to prevent the wasting of the raw slopes they were seeded down with a mixture of blue grass, red top and English rye seed, while on some of the slopes Bermuda grass sods or honeysuckle slips were placed on 2 or 3-ft. centers. The grasses have done well, and though the honeysuckle has not made so good a showing it is of comparatively slow growth, and there is hope that it may yet become entirely satisfactory.

On certain sections of the line heavy reballasting was considered necessary in connection with this work. At these points the alignment of curves was carefully checked and the track put on proper line. Grade stakes were then given, and the track was raised and reballasted with gravel or crushed stone.

In addition to the normal tie renewals on these sections of the line, such additional ties were renewed as this work was done as would have had to be renewed in the course of the next year under ordinary conditions, so that the new track would not have to be disturbed until absolutely necessary.

Results Beginning to Show

While this work is by no means completed over the entire line of the Cincinnati, New Orleans & Texas Pacific, it has progressed far enough for the results to begin to show. A great number of the sliding or settling fills and soft places have already been treated, and these are now giving little or no trouble. Slow orders are no longer common, even in the worst weather, and on account of the excellent drainage afforded by the widened cuts and the ample foundation given by the completed fills, track once "put" up stays "put" much longer, and track gangs are better able to maintain their whole sections in good riding condition than formerly, while the uniform dressing and careful finish have made a marked improvement in the general appearance.

TEST TRENCH FOR STUDY OF WATER POCKETS
Note penetration of ballast at center of track

This work is being carried on under the general direction of C. Dougherty, chief engineer, and under the direct supervision of M. J. Connerton, roadmaster, and his assistants, J. F. Whiteside and M. Davis.

Street-Cleaning Costs Compared

The vacuum machines employed by the San Diego (Cal.) street-cleaning department covered, during September last, 139.12 miles at a cost of $5.23 per mile; the rotaries covered 146.14 miles at an expenditure of $8.20, and the "white wings" cleaned 703.15 miles at an outlay of $1.91 per mile. These figures are from the monthly report of F. M. Lockwood, manager of the operating department.

Timber Trusses Substituted for 30-Inch I-Beams

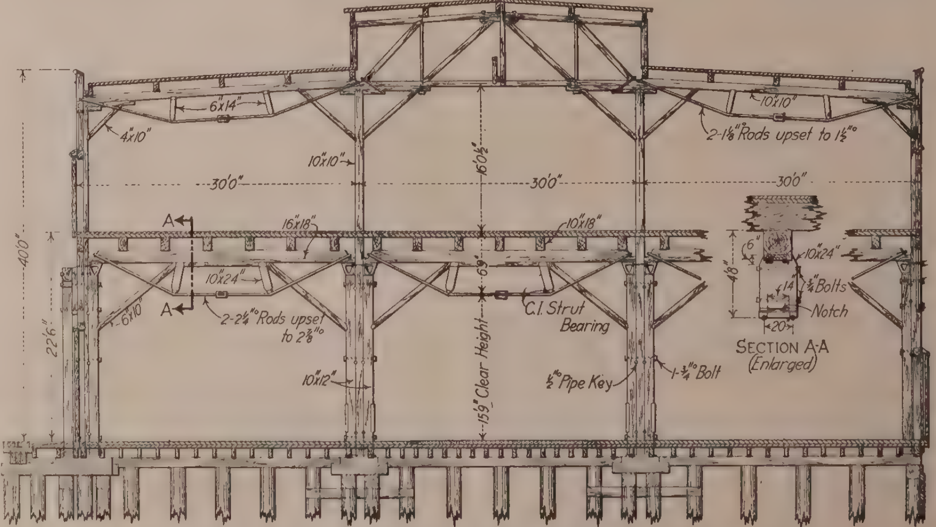
Alternate Designs of Spokane Street Transit Shed, Seattle, Show Economy in Use of Trussed Wooden Beams

IN DESIGNING the Spokane Street transit shed, which is a part of the waterfront-improvement plan being carried out by the Port of Seattle Commission, it was found desirable to have the second floor on a level with the third floor of the adjoining cold-storage warehouse. This gave a total of 22½ ft. between the levels of the first and second floors of the transit shed. Economy of headroom was thus not an element in the selection of the type of support for the second story. A study was accordingly made to compare the advantages of using steel or wood.

The upper floor was required to carry a live load of 300 lb. per square foot, which, with a 30-lb. dead load, made the total loading 330 lb. per square foot. For the 30-ft. span it was found that a 30-in. I-beam would be required if steel construction were adopted, or 16 x 18-in. Douglas-fir timbers with heavy tension rods if a trussed beam were to be used. An analysis of the comparative cost of these two types of construction, which took into account the methods of handling, probable delays in delivery of steel beams and the possibility of serious checking in big timbers, indicated that the 20-per cent saving which would be effected by using timber construction warranted selecting this in preference to the steel. The safety factor of four was considered sufficient to include checking dangers in the timbers. A life of about twenty years was assumed as probable.

Design Adopted

The cross-section of the shed shown in the accompanying illustration indicates the details of the adopted design. Seventy-five of these trusses spaced on 20-ft. centers are now in service in the building. The column footings are supported on an 18 x 18-ft. block resting on a six-pile cluster. The struts between beam and tension rod of the truss are placed at the one-third points and bisect the angle between adjoining parts of the tension rod. The 6 x 10-in. braces, two of which are used with each truss, were put in solely as sway bracing and are not expected to carry any load. An unusual feature is the fact that the heavy timbers



CROSS-SECTION OF FREIGHT SHED SHOWING HEAVY TRUSSED BEAMS of the trusses rest on cast iron caps which are larger on top than on the bottom and are prevented from slipping by a bolt directly through the central timber. Where the 2¼-in. wrought-iron rods pass around the 2½-in. groove in the strut bearing, a ⅛-in. plate of sheet lead is inserted between rod and casting to distribute the stress evenly.

The trusses were first designed with the 16 x 18-in. timbers lying on the flat side. This was done to secure a larger bearing surface at the ends. A final analysis of the proposed design was made, however, employing the theory of least work and considering the truss under four loadings—one-third, one-half, two-thirds and full-span load. This analysis showed that when the beam was placed flat and full load was applied to half the span there resulted an upward thrust in the strut under the unloaded half of the timber which developed there a maximum stress of 1690 lb. per square inch. The city ordinance required that for Douglas fir this value should not exceed 1600 lb. per square inch. A little study then developed the fact that by turning the timbers up on edge the truss could still be built up of the same material without exceeding the allowable cross-bending stress and the compression stress on the cast-iron shoe would still be within the allowable limit of 400 lb. per square inch in bearing.

The structure was designed under the direction of J. R. West, former chief engineer of the Port of Seattle Commission, by J. E. Shoemaker, assistant engineer. Since this work was undertaken Mr. West has been succeeded by G. F. Nicholson. The metal used was shaped in Seattle, the large wrought-iron rods coming from the Seattle mills of the Pacific Coast Steel Company.

Campanile at Berkeley Is Completed

303-Foot Tower on Campus of University of California Has Been Designed to Resist Earthquake Shocks

AFTER long construction delays, the campanile on the campus of the University of California at Berkeley has been completed, and the photograph reproduced on the front cover shows the general architectural effect of the finished structure. The structural features of the tower were described in the Engineering Record of March 14, 1914, page 312.

The total height of the tower is 303 ft., the length of a side at the base being 34 ft. It is a steel and reinforced-concrete structure with a facing of granite. The omission of the lateral bracing in alternate stories of the steelwork gives a flexibility calculated to resist earthquake shocks. The flexibility does not exist in the ordinary structural-steel framing.

The proportions of the tower were determined after a study of the dimensions of all similar structures on which figures were available, and the scarcity of detailed information on tower construction caused considerable comment among local engineers at the time. Comparatively few structures of the strictly tower type have been built in modern times. Most of the examples whose proportions were compared are in Europe and were erected before the common use of present-day materials of construction.

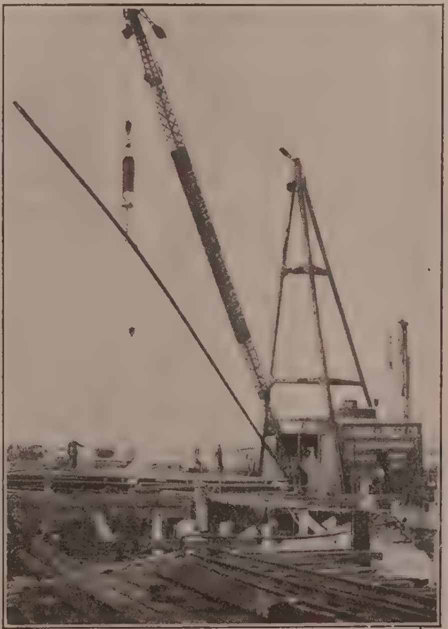
NORTH CUTOFF WALL BEING PULLED AT RIGHT, LIGHTER WORKING ON MAIN DAM

Inverted Hammers Pull 72-Foot Sheeting at New York Pier

400-Ton Tackle Breaks Out First Pile in Inner Line—Bank and Filling Dredged Only to Float Lighters—Air Jets Used

By C. W. STANIFORD
Chief Engineer, Department of Docks and Ferries, New York City

AFTER a 100-ton lighter from whose derrick boom an inverted hammer was suspended had failed to move any of them, the first pile on the inner arc of one pocket of the cofferdam, within which was built the shore end of the new Forty-sixth Street pier in New York City, was pulled with a heavy gallows frame and tackle having a breaking strength of more than 400 tons. The 3600 tons of Lackawanna steel sheeting driven in this dam, thought to be the deepest unbraced coffer ever pumped, consisted mostly of 12¾ x ⅜-in. single-length piles, 72 ft. long. Driven to rock, and surrounded and filled to a depth of 65 ft. or more with mud, clay and riprap, the sheeting in this dam undoubtedly presented the most difficult pile-pulling problem yet met with in this country. Not only is the piling being successfully removed, which is essential to the completion of the project, regardless of the expense involved, but the contractor states that the value of the 2700 tons so far extracted considerably exceeds the cost of pulling it.



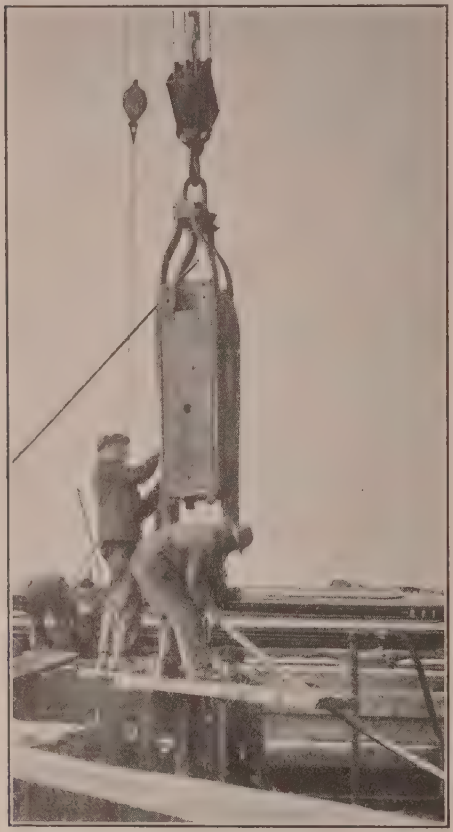
15-TON LIGHTER LANDING 72-FOOT PILE

In view of the fact that it has been contended that the process of extracting sheet piles with an inverted steam or air hammer is suitable only for lighter work, where the penetration does not exceed 40 ft., the success of this method at the Forty-sixth Street pier with piling 72 ft. in length is of especial interest. After breaking out the first pile of the inner line, every piece that could not be started directly with the larger lighter employed has been pulled with inverted McKiernan-Terry hammers, operated with air and usually rigged as shown in the photograph. Three of these hammers are used. They are attached to the piles with 3-in., 3½-in. and 4-in. pins, to receive which a single hole is burned in each piece of sheeting about 2 ft. below the top, and also with pile grips. More than one type of grip has been tried, but the most successful is a relatively light one furnished by the Lackawanna Steel Company, which is rigged so that it can be opened by pulling a trailing rope when the pile has been pulled out of reach from the ground. This grip, which catches the pile by the top of the web, has been used continuously by one lighter for all but the hardest pulling. The hammers are handled by a 15-ton and 40-ton lighter and by stiffleg derricks set to reach the piling in the upper and lower arms of the coffer. The 40-ton lighter was able to pull many of the piles in each pocket, after the first one had been extracted, without using the hammer.

FIRST PILE HARD TO PULL

It was recognized that the friction in the interlocks offered the greatest resistance to be overcome which could not be relieved by jetting, and that this friction would be much greater in the first pile to be pulled than in the others. The inner line was the more difficult to break, possibly because the tension in the sheeting while the dam was pumped out had been greater than in the outer line, due to distortion of the pockets. A 100-ton lighter was secured with the intention of using it, with an inverted hammer, to break one of the inside arcs. As this rig was unable to budge the first inside pile in several pockets, and after working four days had only extracted two pieces of sheeting on the outside of the dam, it was dispensed with. A heavy gallows frame was then erected from which was suspended a 16-part tackle of ⅞-in. wire rope. The capacity of this tackle exceeded 400 tons, and it successfully extracted the key pile with an estimated pull of about 350 tons. The main fall of one of the lighters was luffed to this tackle for pulling.

As it was desirable at times to maneuver the lighters over the line of the cofferdam where the sheeting had already been pulled, the banking on each side and the filling in the cells were dredged down to a point several feet below low tide. No digging was done, however, to relieve the friction on the piles. This was successfully accomplished with air jets, two of which are used with each pulling rig. A 2-in. line from the compressor plant, which operated the drills while the rock excavation inside the cofferdam was being completed, supplies the jets and hammer of each rig. About 100 lb. per square inch is carried at the compressor plant, which reduces to 80 at the jets. In place of the ordinary plug cock for operating the hammer, a globe valve and a lever valve set next to each other in the air line are used. The lever valve, used to stop the hammer, is quicker in operation than a plug cock, while the globe valve makes it possible to regulate the speed of the hammer much more easily than can be done with a plug cock.



HOOKING ON THE HAMMER

Pair of straps below large pin under hammer connect it to pile. Chain is for handling piles after hammer is disconnected. The bent lower end of an overdriven pile shows at right on deck of lighter.

Good Progress Made

A few of the piles were unfortunately overdriven and curled up at the bottom where the rock ledge was struck. These have to be hammered every foot of the way to the top, and in order to handle them with any facility they must be cut into at least three pieces as they are pulled. Striking several piles of this sort in one day, one rig pulled only ten pieces. The usual progress, however, is more than 20 piles a day, and one hammer has pulled 34 in 8 hours. This compares with a record of 65 piles in 6 hours on the upper arm, where the penetration was about 27 ft., and 43 in 8 hours on the lower arm, where the piles were driven from 40 to 53 ft. An oxyacetylene cutting outfit is used with each rig, and is invaluable for burning the pulling holes in the piling and for cutting off bent pieces. Most of the piling extracted is in exceptionally good shape.

The river arm of the cofferdam has been pulled for most of its length and the filling near the middle will now be dredged down to permit the completion of the outer-pile portion of the pier. The upper cutoff wall of the cofferdam, which consisted of a single row of steel sheeting driven to rock, had already been pulled by derricks. The 15-ton lighter will probably be released, and the 40-ton lighter will finish extracting the piles in the upper and lower ends of the river arm and in the two large cylindrical pockets at the southwest corner of the dam. The lower cutoff wall of the coffer, which consisted of pockets of shorter sheeting driven to rock, has also been pulled by derricks, one of which is now pulling part of the nearest cylindrical cell, which is within easy reach of it.

The Forty-sixth Street pier has been built by the Holbrook, Cabot & Rollins Corporation for the Department of Docks and Ferries of the City of New York, of which R. A. C. Smith is commissioner and the writer chief engineer. Thomas B. Bryson is in general charge for the contractors, and Daniel A. Hughes is superintendent.

Activated-Sludge Process Given Preference

Success with Sewage-Disposal Methods Compared by R. V. Orbison on Return from Country-Wide Trip

"Such excellent results have been recorded in the past eighteen months with the activated-sludge method of sewage treatment that it seems highly probable that this method will eventually supersede all others where a high degree of purification is necessary." These are the conclusions of T. D. Allin and R. V. Orbison, commissioner of public works and city engineer respectively, of Pasadena, who recently completed a trip over the United States for the purpose of examining and comparing sewage-disposal plants.

"Some plants showed better design and better maintenance than others," the report states. "The Atlanta (Ga.) plants, by reason of their size and excellent maintenance, were the most interesting of the Imhoff plants visited, but the Pennypack plant at Philadelphia, the Fitchburg (Mass.) plant and the Batavia (N. Y.) plant, although of much smaller units, were giving most excellent results. The Fitchburg, Batavia and Mount Vernon (Ohio) plants of the Imhoff type in operation were the most conspicuous by close proximity to habitation. At Fitchburg good residences were at a distance of about 750 ft. from the plant, Batavia 380 ft. and Mount Vernon about 500 ft., with paved streets and a population of about 500 living in good homes within a quarter of a mile." At no Imhoff plant visited were odors detected at more than 200 ft. from the plant, and in most cases the distance was much less.

Activated-sludge plants, it was noted, are also safely operated very near residences. In fact, in Cleveland a plant using the activated-sludge process is within 300 ft. of high-class residences. The application of a press to dewater the sludge, such as is used at Milwaukee, it was observed, leaves no room for doubt as to the possibility of handling it without odor. Whether resort to the activated-sludge method is warranted is a problem to be determined by local conditions, the report points out, and must be settled in each case independently. As opposed to the fact that it probably represents the most perfect process now known for reducing the danger of pollution from the effluent, it is pointed out that it is sometimes expensive to handle the sludge without odor on account of its high percentage of water.

"By comparing the activated-sludge process with the Imhoff tanks and sprinkling filter process," the report states, "we find that the former occupies less space, costs less for construction, gives a better effluent, and is absolutely odorless. The cost of operation, however, is greater than with the latter process, but its sludge has a higher fertilizing value, and the revenue derived from its sale will reduce the difference in cost of operation."

How the Army Used Motor Trucks at San Antonio

Quartermaster and Commissary Departments Had About 150 in Service in Companies of Thirty Trucks Each

The way motor trucks were used by the army at San Antonio is beginning to be told as the boys get back home. D. A. Tomlinson, quartermaster sergeant, Company A, Illinois Engineers, states that at Camp Wilson the quartermaster's department maintained a section of motor trucks organized in companies of thirty trucks each, attended by an oil-supply truck and repair truck. A squad is composed of ten trucks. About 150 were on hand in the service of the quartermaster and commissary departments, but the number varied as they were distributed along the border and received from the manufacturers.

At San Antonio most of the trucks were Peerless or Locomobiles equipped with bodies made by the J. G. Brill Company. The rated capacity was 3 tons, but Mr. Tomlinson says they looked like the 10-ton trucks in Chicago, and the drivers claimed they would carry 5 tons over any road. In fact, they plowed all over the open fields and rough, muddy roads, he says, without difficulty. On the Leon Springs marches (35 miles) they frequently pulled mule-drawn wagons up steep hills while under load themselves. The batteries used them to haul the field guns, caissons and limbers, one truck sometimes pulling two guns, two caissons and four limbers.

The bodies are patterned after those in use on the wagons, but are much larger. Light frames are provided over which canvas covers may be stretched to protect the loads. Battleship gray, except for the black radiators, is the color of all equipment.

Literature

For the Civil Engineer and Contractor

New Publications

Specifications for the Construction of Vitrified Brick Street Pavements and Highways. Green Concrete Foundation Type. Paper, 6 x 9 in.; 36 pages; illustrated. Sand-Cement Super-Foundation Type. Paper, 6 x 9 in.; 46 pages: illustrated. Cleveland, National Paving Brick Manufacturers' Association.

Handbook—Dominion Bridge Company, Ltd., Montreal. Flexible leather, 4 x 6½ in.; 115 pages; illustrated. Montreal, Canada, Dominion Bridge Company, Ltd.

Centennial Celebration of the U. S. Coast and Geodetic Survey, 1916. Cloth, 7 x 10 in.; 196 pages illustrated. Washington, Government Printing Office.

Proceedings at centennial celebration held in Washington, April 5 and 6, including addresses by representative leaders in scientific and engineering life outlining the value of the operations and results of the first century of the Survey's existence.

Annual Report of the Water Supply Commission of Pennsylvania, 1915. Paper, 6 x 9 in.; 403 pages. Harrisburg, Pa., William Stanley Ray, state printer.

Presents data on stream flow and rainfall, flood damages and a comprehensive policy for administering the control and use of Pennsylvania streams and supervising dam construction.

Contracts, Specifications and Engineering Relations. By Daniel W. Mead, consulting engineer, professor of hydraulic and sanitary engineering, University of Wisconsin. Cloth, 6 x 9 in.; 535 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $3 net.

The Accounting and Reporting Methods of the State of New York. Bureau of Municipal Research Bulletin 74, June, 1916. Paper, 6 x 9 in.; 212 pages. New York, Bureau of Municipal Research, 261 Broadway. $1 net.

Economic Surveys of County Highway Improvement. By J. E. Pennybacker, chief of road economics, and M. O. Eldridge, assistant in road economics, Office of Public Roads and Rural Engineering. Bulletin 393, U. S. Department of Agriculture. Paper, 6 x 9 in.; 86 pages; illustrated. Washington, Government Printing Office. 35 cents

A compilation and analysis of data in eight selected counties, showing comparative financial burdens and economic benefits resulting from highway improvement during a period of years.

Principles of Labor Legislation. By John R. Commons LL.D., professor of political economy, University of Wisconsin, and John B. Andrews, Ph.D., Secretary of the American Association for Labor Legislation. Cloth, 6 x 9 in.; 524 pages; illustrated. New York City, Harper & Brothers. $2 net.

Books Reviewed

Final Report on Construction of Los Angeles Aqueduct

Cloth, 8 x 11 in.; 319 pages; 117 illustrations, in addition to several folding maps. Los Angeles Department of Public Service. $1.95.

Several months ago the Department of Public Service of Los Angeles, Cal., announced its intention to publish and distribute, without profit to the department, a final report on the construction of the Los Angeles aqueduct. Before the volume went to press on Sept. 1 more than 2000 subscriptions had been received. This led to a decision to change the size of the edition from 2500 to 5000 copies. From this response but one deduction could be made. Engineers expected to find in the printed pages the same standards of excellence which had characterized the actual construction of the great water-supply conduit. That these hopes have been amply fulfilled is demonstrated by a copy of the report, just issued.

As a matter of fact, the expression "report" does not do justice to the volume. The ordinary conception of an engineering report on municipal work resolves itself into pages of tedious reading, fine type, interminable tabulations of dry statistics —in fact, something no one would think of reading except under the necessity of extracting definite figures for application elsewhere. It is somewhat of a shock therefore to discover that the Los Angeles report, in its general form, actually invites, rather than repels the reader.

It is printed in large, clear type, and instead of the usual blotches which pass for illustrations in printed engineering documents it is embellished on every other page or so by handsome full-page halftone reproductions, 6 x 9 in. in size, their generous proportions and clear-cut detail conveying instantly to the reader's mind an impression of magnitude and difficulties successfully mastered.

Another unusual thing about the volume is that it is written for the reader, not for the author. It gives the man who has not lived on the job a comprehensive understanding of the problems involved and of the various details of design and construction. When will engineers, as a class, realize that this is the only way in which they can secure for their work the appreciation it deserves? The Los Angeles engineers, when the aqueduct was finished, had a real story to tell. They have told it well.

Practical Cost-Keeping for Contractors

Author, Frank R. Walker. Cloth, 4½ x 7 in.; 273 pages; illustrated. Chicago, published by the author, 30 North Michigan Avenue. $2.

Building construction is generally recognized as a most complicated class of work to keep track of from the estimator's point of view. Perhaps for the very reason that such a multitude of trades and such a diversity of materials enter into modern building erection that estimating without accurate data would ruin any contractor, those who do large building work have long since developed excellent cost-keeping systems. Some of these systems far surpass in simplicity and reliability the primitive methods still very generally in vogue among contractors for other classes of construction work. Even some of the largest of these could learn much from their brethren in the building field, had they ready access to the latter's files and office methods.

For this reason a book outlining a cost-keeping and office-record system compiled from the best practice of these building contractors is a most welcome addition to a literature on cost-keeping which already contains too much out-of-date theory and too little up-to-date practice.

Effective Record System

The make-up of the forms for this system strikingly shows that cumbersome sheets of desk-top size are not needed even for keeping costs on the largest work. It also shows that the practice of entering time over and over in a multiplicity of check books, time books, report books, distribution books and finally on the payroll is useless. As it is the general custom to pay off weekly on building construction, the forms are all arranged for that length of pay period. They could, however, be adapted to any other.

One distribution sheet, of the same small size as the payroll sheets, is made up each week for each heading under which labor is distributed. The entries on these cards are made up from the timekeeper's checking and from exceedingly simple report cards turned in by each foreman for his gang. The card made out each week shows not only the total and unit cost for that class of work for the week, but the total and unit cost for that class of work to date. It also shows, in addition to the unit cost in money, the unit cost in hours of each class of labor engaged in that operation for the week and to date, and the unit number of hours required to complete a unit quantity of work. All this information can be set down in logical sequence with little necessity for computation. In fact, the entire system involves far less labor than is usually expended on other systems which give nothing but unit costs in money. The method outlined for performing the actual work of keeping the time is exceedingly simple and effective. Other features of job-office accounting are treated in the book fully as well as the subject of keeping labor costs.

While it is to be regretted that the English of the book is not perfect, and that the expression is not always as clear as might be desired, these matters will be of minor consequence to the contractor who makes use of the work to improve his own cost-keeping system. The opinion is ventured that there are few firms outside of the building field who could not derive a great deal of cash profit from a study of this book.

A Text-Book of Practical Hydraulics

Author, James Park, dean of the faculty of mining engineering at Otago University, New Zealand; professor of mining and lecturer in practical hydraulics. Cloth, 5½ x 7¾ in.; 284 pages; illustrated. Philadelphia, J. B. Lippincott Company. $4 net.

Reviewed by A. G. Hillberg

Hydraulic Engineer, New York City

This book comprises the author's lectures on practical hydraulics at the Otago University in New Zealand, suitably revised and enlarged so as to cover the course of study as now prescribed by the British government for technical colleges and schools of mines.

The author first explains fundamental principles and gives definitions of the usual terms, discusses the flow through orifices and short tubes and then the friction in pipes and channels, giving only the Darcy formula for iron pipes and the Weisbach equation for open conduits. For curves in bends the usual Weisbach formula is recommended. However, the scantiness of the information on this subject has been remedied in the next chapter, which deals with the discharge of pipes, and in which the author discusses formulas devised by Eytelwein, Neville, Hamilton-Smith and Box. The latter formula, used considerably by English engineers, is practically unknown in this country. The flow of water from nozzles is explained in a very elementary way.

In the chapter entitled "Flow of Water in Open Channels" the Bazin and Kutter formulas are given, but there is no information in respect to their limitations.

Numerous folding plates contain diagrams for use in calculating the flow. For calculating the flow of water over weirs and notches the author recommends the formulas derived by Francis, Robert E. Horton, Cippolette and James Thomson. None of the newer exponential formulas is mentioned. Floats, current meters and Pitot tubes are described and their use for measuring the flow of water in rivers explained.

Run-Off and Evaporation

The relationship of rainfall to run-off is briefly dealt with, and for computing the run-off the formulas by Coaley, Dickens and Ryve are given. All of them are notoriously inaccurate and give results so approximate as to render their use of doubtful value. For figuring evaporation the author recommends the Vermeule formula, which includes the total loss of the precipitation, seepage, absorption by vegetation, evaporation, etc. In fact, when figuring the run-off by Vermeule's method these losses are first calculated by the formula given and then the action of the ground storage determined. The result is the flow in inches. Hence, the use of that formula for figuring evaporation is wrong.

Chapter 9 deals with the construction of pipes and their preservation, testing and anchoring. The construction of flumes is the subject of the next chapter. Many details of timber and iron flumes and the various methods of supporting them over gullies and streams are shown. The next chapter deals with the control of ditches.

The chapter on the construction of masonry dams is too brief. The formulas given are those of Molesworth and Maxwell, which now have historical interest only. For curved dams, the author furnishes the usual arch formula based on the assumption that the pressure line goes through the center of the section. The problem is not quite as simple as that. Earth dams are better treated, and information of considerable interest is supplied. For instance, how to figure the height of waves on a reservoir so as to insure the dam against overtopping is discussed.

Water Power and Prime Movers

In the last chapter the author deals with water power and water prime movers. The matter is limited to Pelton wheels and Francis turbines, and several good pictures show such installations. The treatment is brief and intended to give the reader an idea of how such prime movers work. For exhaustive information, references to other books are given. In an appendix are presented some specifications which have been used for work in New Zealand, such as earth dams, ditches, ironwork (mostly piping), and a 30-in. siphon.

Judged as a whole, the book seems to be well adapted for the use of English students requiring some knowledge of hydraulics. Little new matter is presented, and the author avoids as much as possible going outside of England and its possessions for material. A number of new American and European formulas have not been included, which lessens the value of the book.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Heartwood Specification and Density Rule

Sir: I read with interest the editorial in your issue of Oct 28, page 519, entitled "Heartwood Specification Needed to Get Best Grade Timber," as the matter has very recently developed in connection with some boat-building operations.

The U. S. Engineer Office at Washington, D. C., was about to build some scows on barges and wanted a specification to cover suitable timber, as the local grading rules do not provide such timber for boat-building purposes. Of course all heart would have filled the requirements, but it was thought a suitable timber might be secured without necessarily paying for the best heart timber.

The density rule covering the rate of growth and the inspection was considered very good, but the deficiency in the grade of heart timbers was immediately apparent. The desire in the case at hand was to get, especially, a durable timber that did not have sapwood on all four corners, as previous experience with this class of timber has amply demonstrated that it will not stand up in boat-building work.

Accordingly, the following clause, among others, was developed in the specifications to fit the conditions warranted by the use of the timber, effort being particularly made to adhere to the adopted specifications as closely as possible:

For yellow pine, "All pieces of various sizes of timbers shall show all heart on one of the wide faces and shall show at least two-thirds heart at all points across the opposite (wide) face throughout the entire length of the piece."

This clause was also included:

"Douglas fir shall be classified, graded, inspected and accepted under the same requirements, with the same restrictions, etc., of the foregoing specifications for dense Southern yellow pine. The "density rule" of the Southern Pine Association is practically the same as the "grading rule" for Douglas fir proposed by the U. S. Forest Service, published in Engineering Record No. 7, Vol. 73, Feb. 12, 1916."

Edwin A. Schmitt,
Draftsman, U. S. Engineer Office.
Washington, D. C.

Paving Petitions—The Right Kind

Sir: With your editorial "Paving Petitions—The Right Kind" in the Engineering Record of Oct. 14, page 458, I most heartily agree. The statements express exactly our experience in this city. For the past four years, at least, this department has maintained that the selection of the type of pavement for any particular street should be a matter for determination by the engineer in conjunction with the city commission, and not by petitions circulated among property owners by persons interested in any particular kind of pavement. The fact is that if any pavement as laid, whether recommended or opposed by the engineering department, prove defective the blame is laid against that department.

I am glad to be able to state that at the present time the types of pavements being laid on the various streets are generally recommended directly by this office, and though there are still some petitions presented for particular kinds of pavement, such types have only been designated by the Board of Commissioners after approval by this department.

It is generally admitted by practically all property owners that they are technically unfamiliar with the qualities of the various pavements and must necessarily depend for their information either upon the engineering department or upon the representatives of some particular paving interests. That it is safer to depend upon the judgment of the city's representative than upon that of some interested party goes without saying.

Sylvester Q. Cannon,
City Engineer.
Salt Lake City, Utah.

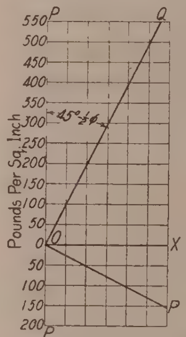
Design of Sand Boxes to Lower Arch Centers

Sir: I beg leave to call to your attention an error that crept into the fourth equation, page 532, of the article "Theory and Tests Presented for Design of Sand Boxes to Lower Arch Centers," in the Engineering Record of Oct. 28, 1916. The equation should have been printed as follows:

$$x = -\frac{1}{m}\log\,(w - mq) + \frac{1}{m}\log\,(w - mQ)$$

Frank P. McKibben,
Professor of Civil Engineering, Lehigh University.
South Bethlehem, Pa.

Sir: While reading the article by Prof. Frank P. McKibben on "Theory and Tests Presented for Design of Sand Boxes to Lower Arch Centers" in your issue of Oct. 28, page 530, there occurred to me a simple method of solving the equation $p = q \tan^2 (45° - \frac{1}{2}\phi)$ graphically for p after q has been computed by the formula there given.



In the accompanying figure let the straight line OQ be drawn from the origin of co-ordinates making an angle $45° - \frac{1}{2}\phi$ with the axis of ordinates, and let the line OP be drawn perpendicular to OQ.

To determine a value of p find the known value of q as a positive ordinate limited by the line OQ, and read p as the corresponding negative ordinate limited by the line OP. This figure is constructed for $\phi = 36°$, which suits the illustrative problem given in the above article. One value of q found there is 550. On our diagram we see that when the positive ordinate is 550, the negative one, p, is 143. Again for $q = 408$ we find $p = 106$. Similarly the value of p corresponding to any value of q may be found.

Jos. B. Reynolds,
Assistant Professor of Mathematics and Astronomy, Lehigh University.
Bethlehem, Pa.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

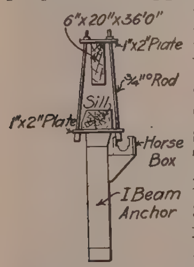
Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Hurters Suspended from Timbers in Concreting Dam Foundation

By KARL H. SCHRIVER
Junior Engineer, U. S. Engineer Office,
Racine, Ohio

THE CAST-IRON hurters and oak sills embedded in the concrete foundation for the navigable pass at government dam 24 on the Ohio River are suspended during concreting from timber girders spanning the length of one foundation monolith to avoid the alternatives of stopping the work of concreting in order to place them or of using timber supports which would have to be embedded in the concrete. The 4-ft. wide wickets of these dams seat on oak sills which are anchored to vertical I-beams embedded in the concrete. To the upper end of these beams on the downstream side are bolted the cast-iron horse boxes about which the wickets hinge. Anchor beams and horse boxes are assembled in the form and bolted to the sill, from which they hang during concreting. The hurters are flat, rectangular cast-iron tracks in which the props that support the wickets slide when the latter are raised or lowered. These castings weigh about 900 lb. each, and as there is one for every wicket, they are spaced on 4-ft. centers. The problem of supporting to accurate line and grade the sill and hurters for a 30-ft. monolith during continuous concreting is a difficult one, which has usually been solved by building solid timber supports for the purpose and leaving them embedded in the concrete.



At dam 24 the sill is supported by a 6 x 20-in. by 36-ft. timber placed directly above it and resting either on bents outside the form or on the sill of a completed monolith on either side. Steel rods, threaded at both ends and passing through 1 x 2-in. plates, support the sill with its attached anchor beams every 4 ft. The sleeve nuts shown on the bottom of the rods in the accompanying sketch remain embedded in the concrete after the rods are removed. The hurters, as may be seen in the photograph, are suspended from two timber girders, each made of two 3½ x 19-in. plank 40 ft. long, bolted together with 1-in. fillers between. These girders are placed 7 ft. apart and each hurter rests on a pair of 1 x 3-in. oak seats 2 ft. long hung from the girders by ¾-in. rods passing through the space provided by the 1-in. fillers and secured at the top by a nut and plate washer. As the concrete is brought up to the top of the castings, the oak seats, which with the sleeve nuts below them remain embedded, are out of sight. The sill and hurters are hung before concreting is started, but are accurately placed and leveled just before the concrete reaches them.

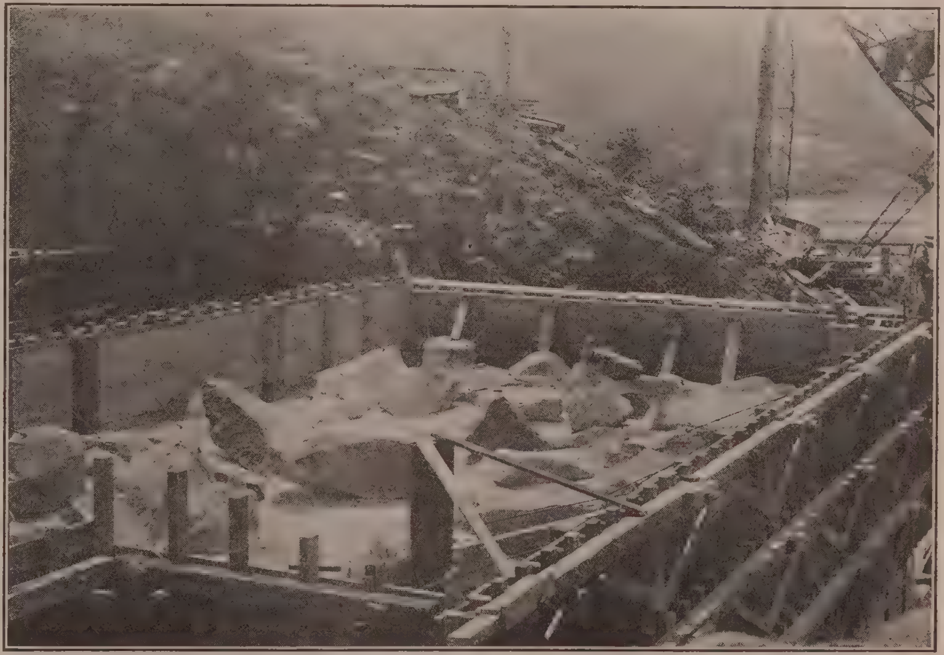
TIMBER GIRDERS SUPPORT CASTINGS TO ACCURATE LINE AND GRADE DURING CONCRETING

The dam is being built by the Sheridan-Kirk Contract Company for the United States Government under the direction of Major T. H. Jackson, Corps of Engineers, U. S. Army.

New Type of Cantilever Form Saves Erection Time

THE SEMI-CANTILEVER type of form being used in building the Yadkin River dam, described on page 610 of this issue, is stated to have greatly reduced the time required for handling and setting forms on this work. Differing from the forms used for heavy work of this character on the Panama Canal and on the Welland Ship Canal, these forms have no cantilever members outside the horizontal waling pieces. The bottom of each form is held by cleats between the waling piece at the top of the form below and the outside edges of the vertical studs. The lower ends of the studding in the top form bear against these blocks and transmit through them to the waling piece the pressure from the concrete. This waling piece in turn is held by tie rods embedded in the previous lift of concrete. It is thus unnecessary to secure the upper set of forms to the lower one in any way, and the tie rods to the waling piece of each form at the top constitute the only connection to be broken before the form can be lifted out of place by the derrick.

However, cantilever action is not relied on to support the top edge of the form, as with the other types referred to. The tie rods which are passed through the top waling piece of the upper form are anchored to the plumb stones placed in the previous lift instead of being left free until embedded in the new lift of concrete. Although the forms are only 6 ft. in height, it is considered cheaper on this work to anchor the tie rods to dogs in holes drilled for the purpose than to embed them at the time the previous lift is poured. Holes are drilled about a foot deep in the stones selected, or in the old concrete, with a small air hammer. The tie rods have several inches of thread on one end and an eye on the other into which is forged the eye of a short rod about 1 ft. long. The latter is driven into the hole drilled for it after the threaded end of the tie rod has been put through the hole bored for it to the outside of the wale. The rod is drawn tight by screwing up the nut on the outside. It is easy to judge accurately the location of the holes in the plum stones, any slight inaccuracy being taken up by wood washers outside the form.



RIGID CONSTRUCTION, ONLY ONE WALE TO A FORM AND NO CONNECTIONS EXCEPT TIE RODS

The dam is being built for the Tallassee Power Company, a subsidiary of the

Aluminum Company of America, by the Hardaway Contracting Company, Inc., for which S. S. Scott is superintendent. J. E. S. Thorpe is resident engineer for the power company, of which Edwin S. Fickes is chief engineer.

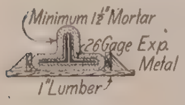
Shallow Form as Aid in Coating Roof Trusses with Cement Mortar

By R. C. HARDMAN
Balboa Heights, Canal Zone

IN COATING individual members of the roof trusses, longitudinal trusses and monitors of some large reinforced-concrete and steel pier sheds recently completed in the Canal Zone, shallow forms were used to pour the mortar around the lower flange of the members, which consisted of angles back to back, and the vertical legs of the angles were plastered and finished with a screed. The coating of 1½ in. of cement mortar, held in place by a wrapping of No. 26 gage expanded metal, was applied as a protection against fire and rust.

The main trusses were 80 ft. center to center of building columns, the lower chord being approximately 25 ft. above the deck of the pier. There were two bracing trusses between main trusses in each bay. All members of the trusses and monitors were coated except the upper chords, which were incorporated in the roof slab. The work was carried on from light wooden trestles supporting a working platform directly under the lower chord. These trestles were in units, mounted upon wheels for easy moving, long enough to reach from end to end of main trusses, and about 6 ft. in width. As the trusses were but 17 ft. center to center, these platforms were connected by plank walkways for easy intercommunication and for coating the longitudinal trusses.

A cement gun was first tried for the work, but without satisfactory results, due to the large waste of material caused by the smallness of the sections. After discarding the cement gun method a wooden form built up to the exact shape desired was tried. This also proved unsatisfactory, as the space of 1½ in. between steel and form was too small to permit the mortar to thoroughly cover the bottom faces. The mixture used was also too wet for good construction.



The method finally adopted was to use a light, shallow trough blocked in position under the member. This trough, shown in the accompanying section, was then filled with a comparatively dry mixture and the upstanding legs of the angle members were coated and formed by means of a combination trowel and screed similar to the one described by the writer in the Engineering Record of March 25, 1916, page 429. The trough forms for the lower chord were blocked up directly from the traveling platform and those for the inclined members were blocked from the lower chord. The vertical members were covered by troweling alone. The truss members, which were of angles back to back, were first thoroughly cleaned by means of wire brushes and then tightly wrapped with expanded metal wired in place. The trough form was then placed and filled sufficiently to give the horizontal portion of the member its proper cover. The upstanding legs were then covered and formed by the trowel-screed. Joints between members were formed by a trowel.

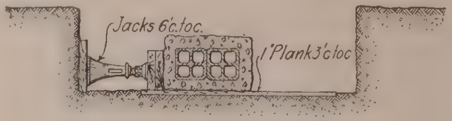
The work was carried along by three gangs of about ten West Indians each, the three gangs being under one American foreman. One gang erected, wrecked and re-erected forms, the second did the pouring and shaping, while the third was the plaster gang putting on the finishing touches. All concrete was mixed by two Smith hand-mixers and hoisted by rope and pulley in galvanized-iron buckets. The large gusset plates forming kneebraces at the ends of the trusses were coated by pouring into a solid form enclosing the entire plate.

The 84 main trusses, 84 monitors and 168 longitudinal trusses covered required about 12,000 sq. yd. of expanded metal, which cost about 8 cents per square yard to place. The main trusses required 414 and the longitudinal trusses 150 cu. yd. of mortar. This mortar was placed at a cost of $18.33 per cubic yard, with cement at $1.17 a barrel, sand at 86 cents a yard and common labor at 13 cents an hour. After the preliminary experimenting the work was carried along at the average rate of a bay per day—one main truss, one monitor and two longitudinal trusses. The cost of doing the work decreased steadily as the gangs became more accustomed to the work, the unit costs for the first few trusses being quite high.

Move Vitrified Duct Line with Screw Jacks

By W. M. STIEVE
Washington, D. C.

BY MEANS of screw jacks 2000 ft. of vitrified duct line belonging to the Brooklyn Rapid Transit Company on Gravesend Avenue, South Brooklyn, was recently moved horizontally in sections between manholes averaging 300 ft. in length. The line was moved a total distance of 30 in., sliding on plank skids. The line had to be moved to make room for the column footings of the new elevated railroad at that point, which were located over the existing duct line. The conduit was so near the surface that it could not be spanned by the footings. The method adopted saved building an entire new line before putting the old line out of service, the only new work required being the construction of additional manholes.



DUCT LINE MOVED WITH JACKS

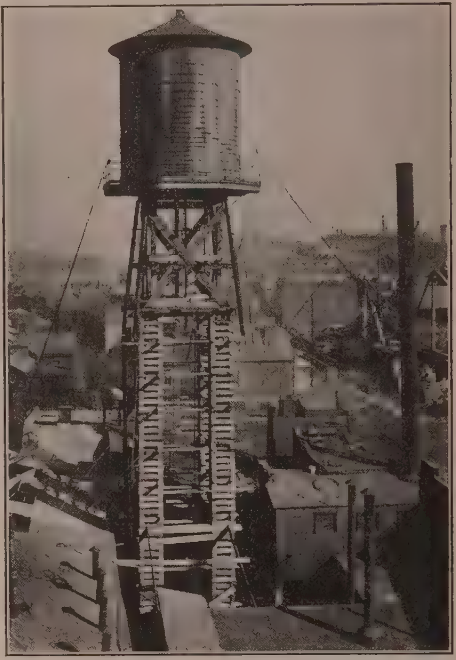
The line consisted of two four-way ducts, 30 in. long, enveloped in 3 in. of concrete. It was uncovered and a trench 30 in. wide on one side and 18 in. wide on the other excavated to the bottom of the concrete envelope. One-inch planks were then set underneath the line as indicated in the accompanying sketch, and a large number of screw jacks were placed against blocking on the narrow side of the trench. A man stationed at each jack took a half turn at a signal from the foreman, and each continued to turn his jack in response to signals till the move was complete. In this way a nearly equal pressure was kept up along the whole length of the section being moved. To make sure that the line was moving evenly and was not overstressed at any point, graduated sticks driven horizontally into the back at intervals were watched carefully. The current was shut off only a few hours each day while the actual moving of a section was in progress. This interruption was possible without inconvenience because of the nature of the service for which the conductors were used.

The entire 2000 ft. was moved without any damage to the electrical conductors. A few cracks developed in the concrete envelope, which were readily repaired with cement mortar, and a few of the tile ducts were broken and had to be replaced by split ducts.

Raise Tank 50 Feet on Cribbing Tied Together with Plank

By JOHN P. EICHLEAY
Pittsburgh, Pa.

GUYED WITH wire rope and steamboat ratchets, the 16 x 20-ft. tank shown in the photograph has just been raised an additional height of 50 ft. with screw jacks and blocking. As the photograph shows, the neighborhood of the tank foundation was pretty well crowded, and there was no room to make the blocking any larger than the size of the original tower, which had supported the tank 32 ft. above the ground. The tank was therefore raised on four towers of timber cribwork tied together every 12 courses with 3 x 12-in. plank in both directions. These planks also provided a convenient support for working platforms. Screw jacks were used, and the tank was caught up before raising began on timber bents erected inside the old steel tower.



TANK RAISED ON ACCURATELY BUILT CRIBWORK

The tank, which is one of those at the plant of the United States Glass Company in Pittsburgh, has been raised by the John Eichleay, Jr., Company.

Wisconsin Builds More Than 1000 Miles of Road This Year

During the present year 1158 miles of state-aid roads have been built in Wisconsin at an average cost of $3,140 per mile.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Railway Committee Reports on "Daylight Saving"

Committee of American Railway Association Thinks Roads Should Not Agree to Time Change Until Adopted Generally

The American Railway Association, at its semi-annual meeting in New York City, Nov. 15, considered a report on the "daylight saving" movement from its committee on standard time. The document, signed by the committee headed by E. B. Thomas, president of the Lehigh Valley Railroad, reads as follows:

"Last May several of the countries involved in the European conflict advanced the hands of the clock an hour during the summer months. Following this emergency action, more or less agitation developed in various sections to make a similar change in this country.

Railroads' Attitude Summarized

"The committee on standard time is of the opinion that the correct stand for the railways to maintain on this subject is as follows:

"First—That the present subdivision, or zone system, of dividing time is scientifically correct.

"Second—That any change in such subdivisions of time would result in endless confusion, and would be disastrous to the railroads.

"Third—That in the event of a nation-wide movement to change the hands of the clock in order to readjust the hours of day-light to the hours of labor, the railroads should not antagonize the movement. It is the feeling of the committee that the railroads will not suffer any very serious inconvenience nor disarrangement of schedules by the change, as proposed, although such a change from a scientific standpoint is not warranted nor is the committee in sympathy with the movement.

"The committee feels that the railroads should not agree to the 'daylight-saving' project until it has been previously adopted by the principal business and municipal centers, together with the state and local authorities. Unless a change of the character proposed can be made on the same date throughout the country it will lead to great confusion and difficulty."

Railroads Sue to Test Eight-Hour Law

Suits to test the so-called eight-hour railroad law have been filed by the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, the Chicago & Eastern Illinois and the Union Pacific railroads. The Chicago, Great Western, Missouri Pacific and the Chicago, Burlington & Quincy roads have also joined in similar action. Reports state that every railroad in the country is considering filing suits attacking the Adamson measure.

The bill of complaint filed by the Union Pacific alleges that the act is unconstitutional because it is not a proper regulation of interstate commerce; because it violates the guarantees of the fifth amendment to the Constitution, and because it is unworkable as applied to existing conditions under which the trainmen are operating.

Open Engineering Department Library

The general engineering department of Union College, Schenectady, is establishing a library and reference room. Bulletins, catalogs and other publications are wanted from state engineering departments, manufacturers and other institutions.

Bridge Under Construction Near Seattle Fails

Falsework of Steel Truss Undermined by Snoqualmie River Flood—Piers Undamaged—Eight Tons Recoverable

A partly completed steel bridge over the Snoqualmie River, near Tolt, Wash., collapsed Nov. 9, when a flood undermined the falsework. The piers are undamaged, but of the 53 tons of materials in the wreck only about 15 per cent can be recovered. The wreckage will be removed and the work resumed next summer.

Through Pratt Truss

The structure was a steel, pin-connected through Pratt truss of 209-ft. span, with a 20-ft. roadway. At the time of the accident, water in the Snoqualmie River was 10 ft. deep, and the span was 30 ft. above the water surface. A freshet caused by warm winds melting the snow in the Cascade Mountains undermined the falsework. Anchor bolts which had been placed at one end, but not grouted, were pulled out by the falling span. The total weight was 106 tons.

The bridge was being built for King County by the Weymouth Construction Company, contractor, of Seattle. As the structure is part of a new line not yet open to the public, no interference with traffic will result from the accident. The contract price was $18,000.

Western Cement Companies Charged with Forming Trust

Indictments, which have been returned by the federal grand jury, charge sixteen cement men on the Pacific Coast with combination in restraint of trade in the organization and operation of a cement trust. The indictment, which was returned Oct. 27, was kept secret until Nov. 8. It charges that prices were fixed, territory assigned, and that the agreement has been in effect since August, 1914.

The firms whose officers are reported to be involved are the Oregon, Cowell, Pacific, Riverside, Santa Cruz, Standard, Superior, Washington and the Olympic Portland cement companies.

California's $15,000,000 Highway Bond Issue Carried November 7

At the general election, Nov. 7, the measure in California which provided for an appropriation of $15,000,000 for State road work was approved by a large majority. As outlined in the Engineering Record of Oct. 28, page 536, the new appropriation includes $12,000,000 for completing the system now under way and $3,000,000 for a county and co-operative plan under which eight additional extensions will be undertaken. The present highway organization will be continued, and the new work is to be started at once. Several counties in California have also voted independent bond issues. Among them are Sacramento County, with an issue of $1,700,000, and Stanislaus County, with a $1,500,000 issue.

Want Uniform Law to Prevent Strikes

The formation of a committee to make suggestions to Congress and state legislatures for the perfection of laws providing amicable settlements of labor disputes was announced last Monday by V. E. Macy, president of the National Civic Federation. Every phase of the country's life will be represented in the committee.

Recommend $7,000,000 Water Terminal at Bayonne

New Jersey Harbor Board Submits Plans and Estimates by B. F. Cresson, Jr., and F. Van Z. Lane to Develop 420 Acres

General plans for the development of a water and industrial terminal at Bayonne, N. J., that, if constructed, will rival the Bush Terminal in South Brooklyn were filed this week with the Board of Commissioners of that city by the New Jersey State Board of Commerce and Navigation, of which J. Spencer Smith is president. The plans were prepared under the immediate direction of B. F. Cresson, Jr., chief engineer of the commission, and F. Van Z. Lane, engineer of the Bayonne Chamber of Commerce. Five schemes were presented. The fifth, designated as Primary Installation 5, is an outgrowth of the other four, and is the one recommended by the engineers.

Location

The site chosen for the development is on the Upper New York Bay frontage of Bayonne, extending from a point between East Thirty-fifth and East Thirty-sixth Streets to East Forty-sixth Street, and from the National Docks Railroad to the pierhead line; it embraces 420 acres, of which approximately 400 acres are under water. The tract is entirely undeveloped. The scheme recommended provides dockage for thirty modern freight ships, a 1000-car railroad yard, with facilities for classifying and assembling freight, a ferry terminal for Bayonne-Manhattan service, 4 miles of bulkhead platform, 1,350,000 sq. ft. of one-story bulkhead sheds, 7,770,000 cu. ft. of second and third-story bulkhead sheds, and more than 200 acres of land for industrial buildings. There would be highway and trolley connections, and along one side would run a railroad having direct connection with practically every railroad reaching New York from the New Jersey side.

The total estimated cost of the installation is $7,235,000, of which $2,122,000 is for dredging, bulkheading, and reclamation, and $5,113,000 for the other facilities. The plan is to provide for a 35-ft. depth of water.

The report is the result of legislation passed a year ago, and a series of conferences early this year between the Bayonne Chamber of Commerce, the City Commissioners of Bayonne, the State Board of Commerce and Navigation, and Irving T. Bush, president of the Bush Terminal Company, looking to the development of the industrial possibilities of Bayonne.

Experts Wanted to Investigate Foreign Markets

To obtain men to act as trade commissioners and special agents for the Bureau of Foreign and Domestic Commerce, examinations will be held Dec. 6 by the U. S. Civil Service Commission. The duties of the appointees will be to present data which will enable American manufacturers to plan campaigns for the sale of their goods abroad.

Men are wanted to undertake the following investigations: Motor vehicles in Russia and the far East; investment opportunities in Russia; metal-working machinery and prime movers in Russia and in Brazil; hardware in Africa, the near East, and India; ports and transportation facilities in Russia and the far East; mineral resources in the far East.

Applicants should ask for form 275, stating the position desired.

Must Raise About $2,000,000 to Complete New Jersey Sewer

The Passaic Valley Sewerage Commission finds that the trunk sewer cannot be built for $11,250,000 subscribed by the fifteen New Jersey municipalities now in the agreement. The cost will probably be at least $13,000,000. Work on the uncompleted tunnel under Bayonne and New York Bay, the most difficult and essential part of the improvements, cannot be resumed until additional money is raised. The legal difficulty will have to be met by application to the legislature for another time extension.

Short Course in Highway Engineering at University of Illinois

The civil engineering department of the University of Illinois announces that in co-operation with the state highway department the fourth annual short course in highway engineering will be held at the University Jan. 8 to 19, 1917. The program, now in course of preparation, is planned to interest those engaged in the development of country roads, the administration of municipal affairs and contracting. Each subject will be handled by a specialist.

While it is intended that the course shall be a continuation of the work of last year for those who have attended previously, courses will also be arranged for those attending for the first time. Special attention will be given matters relating to bond issues and the development of county-road systems. No fee is charged.

Cleveland Company Wins Suit Over Concrete Dock Patent

The Cleveland (Ohio) Dock Engineering Company obtained a favorable decision in an appeal recently brought against it by the Detroit Iron & Steel Company disputing patent 1,089,405 covering concrete pier construction. The Cleveland company, in 1910, designed and built, for the Detroit firm, a concrete dock. In 1913 the latter company attempted to duplicate the dock without recognizing the validity of the patent in question. The Cleveland engineers brought suit and won. The case was appealed, resulting in another victory for the Cleveland Dock Engineering Company.

Propose Texas Highway Commission

A bill has been prepared for presentation to the next legislature creating a state highway department for Texas. The tentative document provides for three commissioners to be appointed by the governor, one of whom shall devote his entire time to the commission at a salary of $4,000. Funds will be raised by an automobile tax of 25 cents per horsepower, the minimum taxation being $7.50 a year and the maximum, $15. It is estimated that this will insure an annual income of $2,000,000. One third of the money is to be returned to the counties in which the machines are registered; two thirds is to be used in the construction of state roads. The bill will be presented next January.

Steamer Breaks Through Canal Lock

Two foot-gates in Lock No. 7 of the Welland Canal were smashed Nov. 5 when a steamer, traveling at too high speed, crashed through the gates and dived into the lock below. Adjacent farms and gardens were flooded. The damage is estimated at $12,000.

Winter Training for New York Engineers in Reserve Corps

Plans are on foot to provide military drill and instruction in military engineering for the members of the Engineer Officers' Reserve Corps in New York City. The organization formed under the name of the Civilian Engineers' Training Battalion, which provided instruction last winter and spring for some 500 of those who attended the military engineering lectures, will be taken into this organization, many of its members having applied for commissions in the Reserve Corps, and a considerable additional number being expected to do so in the near future. The entire training organization will be in immediate charge of Captain Robins, Corps of Engineers, under the direction of the Eastern Department of the United States Army, and it is hoped that exceptionally good facilities for instruction in military engineering can be arranged for with the assistance of the state military authorities.

Open New Tech Dormitories

The new dormitories of the Massachusetts Institute of Technology, which were opened Nov. 6, are the outgrowth of a spirit of co-operation and offer greater opportunities for the students in different courses to become acquainted. The cream-colored brick structures are situated below the educational buildings on the Riverway and are one of the first examples in Boston of the Florentine style of architecture. Student government will be the policy in the new dormitories.

Engineering Society Activities

Engineers' Club of Trenton, N. J., will, at its Nov. 22 meeting, entertain as its guest Harrington Emerson, of the Emerson Company, of New York City. He will speak on efficiency.

Engineers' Club of Philadelphia will hold a meeting Nov. 27 for junior members. Telephone engineering will be the subject of lectures by A. P. Godsho, A. L. Gracy and J. H. Mahan. A prize of $50 will be awarded, at the end of the club fiscal year, for the best paper by a junior member describing an engineering work with which the writer has been connected, or recording investigations contributing to engineering knowledge.

Colorado Association of members of the American Society of Civil Engineers was addressed Nov. 11 by M. H. Aylsworth and Fred J. Rankin, chairman and engineer respectively of the Colorado Public Utilities Commission. "State Control of Public Utilities" and "Regulation from a Engineering Standpoint" were their topics.

The Associated Engineering Societies of St. Louis heard Capt. Offnere Hope, Coast Artillery Corps, U. S. A., speak Nov. 15, on "Our Coast Defenses." The meeting was held under the auspices of the local section of the American Institute of Electrical Engineers. At a future meeting L. C. Nordmeyer will give personal experiences and observations on China.

Cleveland Engineering Society will meet Nov. 21. F. H. Newell and Isham Randolph will speak on "A Practical Plan of Co-operation" and "What the Established Technical Man Owes to the Beginner." Hunter McDonald will outline to the meeting reasons why a government nitrate plant should be located at Muscle Shoals. The subcommittee on plan, of which Mr. Newell is chairman, will also meet Nov. 21 in the Cleveland society rooms to draft a plan for submission to the third conference of the committee on co-operation to be called in Chicago early in 1917.

Harvard Engineering Society of New York will hold its tenth annual dinner at the Harvard Club, Dec. 7. President A. Lawrence Lowell and W. S. Kies, vice-president, American International Corporation, are among the speakers.

Municipal Engineers of the City of New York, at their Nov. 22 meeting, will hear Edward M. Blaw, assistant engineer, Board of Estimate and Apportionment, New York City, tell of the preparation of the building district maps of the city. Special entertainment will be provided Nov. 25, instead of the customary program.

What Engineers and Contractors Are Doing

FRANCIS C. SHENEHON, of the University of Minnesota, who has been engaged on hydraulic investigations in Illinois since last June, has been retained as an expert in the settlement of the terms of a lease for water power between the Marseilles Land & Water Power Company and the Northern Illinois Light & Traction Company. The water power company has a dam across the Illinois River at Marseilles and sells power to the traction company under a lease covering a period of 180 years, five of which have passed. The document is so contradictory that a court of equity has been called upon to determine its real meaning. In addition to Dean Shenehon, Thomas W. Orbison and Isham Randolph, consulting engineers, of Appleton, Wis., and Chicago, respectively, have been engaged as engineering experts to look after the interests of the water power company.

J. R. SHERMAN has resigned as assistant engineer, U. S. Reclamation Service at Meadow Creek, Wash., to go to South America. He will have charge of construction of a large tailings dam near Rancagua, Chile, for the Braden Copper Company.

WILLIAM A. DUFF, whose appointment as assistant chief engineer of the Canadian Government Railways was announced in these columns, has been in the employ of that road since 1913. After graduating from the University of Toronto in 1901 he joined the engineering staff of the Vancouver, Victoria & Eastern Railway. The following year he went to the Grand Trunk Railway and in 1903 entered the employ of the Kenwood Bridge Company at Chicago. That was followed by his appointment in 1905 to a position with the Canadian Bridge Company. During 1907 and 1908 Mr. Duff was chief draftsman in the bridge department of the Transcontinental Railway and from then until 1913, assistant bridge engineer. He resigned in 1913 to go to the Canadian Government Railways.

WILLIAM L. BOWMAN, civil engineer and lawyer, of New York City, has removed his office to the Equitable Building.

E. W. KIBBEY has resigned as county engineer of Koochiching County, Minnesota, and as city engineer of International Falls to take active charge of the Kibbey Engineering Service Company, with offices in the Plymouth Building, Minneapolis. The firm will specialize in service to bonding companies and contractors. G. S. Kibbey and E. W. Kibbey have also organized the Minnesota Construction Company for general contracting, specializing in tile drainage work.

WILLIAM H. VANCE, formerly engineer maintenance of way of the Louisiana & Arkansas Railway, has been made chief engineer. The position he formerly held has been abolished. Mr. Vance has been in the employ of the Louisiana & Arkansas since 1906 and in railway service since 1902.

M. F. CLEMENTS has been promoted from assistant engineer to engineer of bridges for the Northern Pacific Railway, succeeding H. E. Stevens, promoted. Mr. Clements is a graduate of the University of Iowa, class of 1899, and has been with the Northern Pacific since 1907. After graduation he entered the service of the Burlington, Cedar Rapids & Northern Railway, remaining with that road until 1902, when he was appointed chief draftsman for the maintenance of way department of the Chicago, Rock Island and Pacific Railway. A year with the Clinton Bridge Company preceded his appointment with the Northern Pacific in 1907 as draftsman on bridge design. Mr. Clements' advancement was steady and at the time of his recent promotion he was in charge of track elevation at Spokane

Edwin G. Foster, formerly assistant engineer for the Buffalo, Rochester & Pittsburgh Railway, has been made valuation engineer, with office at Rochester, N. Y.

George W. Corrigan has been promoted from roadmaster to division engineer of the Stockton division of the Southern Pacific System. Since graduation from the University of Missouri in 1900 he has been actively engaged in railroad engineering work in the West.

K. A. Sinclair has resigned as acting county engineer of Douglas County, Oregon, and returned to Portland.

Jefferson D. Davis recently returned to New York City from Idaho, where he was superintendent in charge of construction of the Bear Lake pumping station. Mr. Davis is now in Halifax, N. S., serving as expert witness on the failure of a dock, owned by Furness Withey & Company, which collapsed two years ago when a valuable cargo was unloaded thereon.

George W. Townsend, who recently resigned from the Baltimore Sewerage Commission, is now engineer in charge of the safety department of the Barrett Company at Frankford, Pa.

J. H. Fargo has resigned from the employ of Renhart & Donovan, contractors, of Oklahoma City, to become superintendent for Vandenberg & Pawley, general contractors, of Wichita, Kan.

T. B. Hudson, for the last 6½ years chief civil engineer of the Indiana Steel Company, is now engineer in charge of construction at the Maryland plant of the Bethlehem Steel Company. Mr. Hudson was with the Indiana firm for nine years.

Clyde Potts, consulting engineer, of New York City, has been engaged by Stratford, Conn., to design 60 miles of sewers and a sewage-disposal plant. The project will cost $450,000.

Frank J. Phillips, who has been with the Miami Conservancy District since graduation from the University of Iowa in 1915, is now in the sales department of the General Fireproofing Company at Youngstown.

Jacob L. Bauer has been reappointed county engineer of Union County, New Jersey. His office is at Elizabeth.

E. A. Lindberg has left the employ of the Aluminum Company of America to take a position with the Utah Copper Company. He was graduated from the University of Nebraska in 1912 and was with the Aluminum company two years.

H. F. McGregor, formerly superintendent of streets and bridges of Tacoma, Wash., has been appointed superintendent of the water department.

Colin D. Murdock, chief computer of local improvement districts in the city engineering department of Tacoma Wash., for the past seven years, will succeed H. F. McGregor as superintendent of streets and bridges.

Bert Schneider, who was with the engineering forces of H. L. Cooper on the Keokuk power development, is now employed in the engineering department of the Sparrows Point plant of the Bethlehem Steel Company.

W. E. Belcher, of the Stone & Webster Engineering Corporation, has been assigned to work in Akron, Ohio, as engineer representing the structural division. Construction is in progress on four large buildings for the B. F. Goodrich Company.

Richard C. S. Watson, formerly engineer on surface and mine surveys for the St. Joseph Lead Company of Bonne Terre, Mo., is now mine engineer for the Donk Brothers Coal & Coke Company at Collinsville, Ill. After being educated at the Castle Hills and Saint Paul schools, London, England, Mr. Watson went to South America, where, for fourteen years, he was engaged on railroad construction, land and mine surveys, and smelter construction. He returned to the United States in 1911. Previous to his employment by the St. Joseph Lead Company, Mr. Watson was with the St. Louis Smelting & Refining Company.

A. S. Clarson has been appointed city engineer of Verdun, Quebec. He was for some time on the staff of the Montreal Electrical Commission and has also been associated with engineering projects in England.

O. T. Reece, consulting engineer, of Oxford, Kan., has been retained by the commissioners of Comanche County to design and build several concrete bridges. His headquarters will be at Coldwater, Kan., temporarily.

C. E. Painter has resigned from the employ of Black & Veatch, consulting engineers, of Kansas City, Mo., to become associated with the J. P. Sprague Company of that city. Mr. Painter will be engaged on estimates and designs of reinforced-concrete buildings. Mr. Painter's first engineering work was with Calcasieu Parish, Louisiana. That was followed by his appointment as assistant city engineer of Newton, Kan., from which position he resigned to join the staff of Black & Veatch.

Littell Snively has taken a position in the engineering department of the Cananea Consolidated Copper Company at Cananea, Mexico. After graduation from the Colorado State College in 1906 Mr. Snively went to the Philippines in the service of the U. S. government. Since his return to the United States, three years later, he has been in charge of several irrigation projects. He was resident engineer on the Halligan dam at Fort Collins, Col., and also connected with the North Platte (Wyo.) Valley Irrigation Company. He has also been a member of the engineering department of the state of South Dakota.

Howard Corley has resigned from the construction staff of the Babcock & Wilcox Company to become erecting engineer for the William B. Scaif & Sons Company. His headquarters are at Pittsburgh.

Peter Jenny, formerly with the Robert Grace Contracting Company, is now with the J. F. Casey Company. He is employed on sewerage work in Milwaukee.

Sanford E. Thompson, consulting engineer, of Boston, has opened new offices and laboratory in the Federal Street Building. These replace the Newton Highlands and Milk Street offices. The laboratory equipment, which includes a concrete saw and a 125-ton compressing machine, permits handling work of a special nature.

A. E. Foreman has resigned as chief assistant to the city engineer of Victoria, B. C. He had been in the employ of the city for a number of years and assistant city engineer since 1912.

W. C. Pearce, formerly supervisor of track of the Chesapeake & Ohio Railway, has been appointed division engineer with headquarters at Richmond, Va. F. D. Beale is made acting division engineer, with headquarters at Clifton Forge, Va., and H. A. Bertram becomes acting division engineer of the Chesapeake & Ohio Railway of Indiana, with headquarters at Peru.

J. N. George & Sons, contractors, of Shreveport, La., have completed their 30-mile road contract at Baton Rouge and are now starting work on a contract in De Soto Parish calling for 25 miles of road building.

H. N. Legreid has resigned as county engineer of Humboldt County, Iowa, and as engineer for several drainage districts in that vicinity, to become associated with Arthur L. Webster, consulting engineer, of Wheaton, Ill. Mr. Legreid will have charge of the recently opened office at Harvard, Ill. After graduation from the University of Wisconsin in 1907, he was engaged on farm and district engineering and contracting. Five years later he was made assistant office engineer for C. G. Elliott, of Washington, D. C., and in 1914 went to Iowa as assistant county engineer of Humboldt County under J. L. Parsons. He was made county engineer the next year.

J. W. Walter, formerly of the Plains division of the Atchison, Topeka & Santa Fe Railway, has been made assistant engineer in charge of construction of an 80-mile branch line in Oklahoma and Texas.

Black & Veatch, of Kansas City, have been officially appointed consulting engineers to the superintendents of the water and light plants who are members of the Kansas League of Municipalities.

James H. Reding, civil engineer with R. Winthrop Pratt, of Cleveland, Ohio, is on the Mexican border, at El Paso, as first lieutenant in the first battalion of Ohio engineers. He has just completed a detail as adjutant of both the first battalion and the provisional regiment of the engineers, the latter having been recently organized from the militia engineers stationed at El Paso.

C. P. Collins, whose resignation as sanitary engineer of Johnstown, Pa., was noted in the Nov. 4 issue, has re-entered the service of the city and will continue to direct the sanitary work.

S. R. Oldaker has been appointed city engineer of Hermiston, Ore.

R. E. Shuck has been transferred to Spokane to succeed M. F. Clements as assistant engineer on grade separation for the Northern Pacific Railway.

Fred R. Hesser, for four years assistant engineer of the Kansas health and highway departments, has joined the sales force of the General Fireproofing Company at Youngstown, Ohio. Mr. Hesser also served in the bridge department of the Kansas City Terminal Railroad Company.

William Osborne Sell, of the Ferro Concrete Construction Company, Cincinnati, is in Rochester, N. Y., engaged in designing an addition to the Kodak Park plant of the Eastman Kodak Company.

Obituary Notes

George W. Chambers, contractor, of Rochester, N. Y., died recently at the age of 71. Mr. Chambers was associated with the late James D. Casey in contracting work under the firm name of Chambers & Casey. After the death of Mr. Casey Mr. Chambers conducted the business alone. He engaged extensively in railroad building and had contracts for work on the New York Barge Canal.

Leonard Cole Rittenhouse, junior member of the firm of James H. Rittenhouse & Son, civil and mining engineers, of Scranton, Pa., died Nov. 10. Mr. Rittenhouse was a graduate of Pennsylvania State College, and only thirty-two years of age. One of his undertakings that elicited considerable comment was the connection of a 47-deg. slope with a 950-ft. vertical shaft in a zinc mine at Franklin Furnace, N. J.

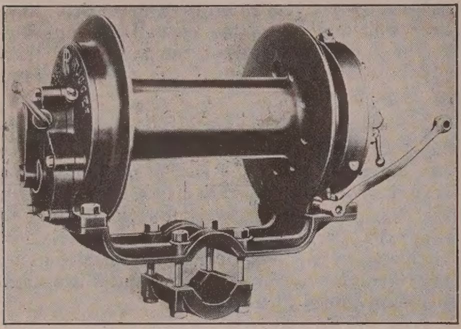
Civil Service Examinations

Massachusetts.—Examinations will be held Dec. 11 in Boston for civil and sanitary engineers. Residents in the state during the last year are eligible.

New York.—Examinations for state, county and village service will be held Dec. 2 in cities throughout the state. Among the positions open are junior assistant engineer, salary $901 to $1,200; junior electrical engineer, salary $901 to $1,200; supervisor of dredging plant, salary $175 per month:

New Model Hoist Is Designed for Light Lifting and Hauling

For those who prefer manila to wire rope for light hoisting and hauling, the Ingersoll-Rand Company, New York City, has brought out a new model "Little Tugger" hoist. The square piston, reversible driving engine, automatic lubricating, inclosed gearing, drum-release clutch and worm-operated band brake are essentially the same as in the No. 1 model. The principal differences are in the diameter and length of the drum, width of flanges and the main frame and overall dimensions.



NEW HOIST OPERATED BY STEAM OR COMPRESSED AIR—WEIGHS 358 POUNDS

Although designed primarily for underground work, it is recommended by the manufacturer for all-around hoisting, hauling and handling in mines, tunnels, quarries and industrial plants.

Tool Company Opens New Factory

The new plant of the Van Dorn Electric Tool Company, Cleveland, which was recently opened, will about double the company's production. The building is made of steel, brick and concrete with maximum lighting surface. The greatest possible effort seems to have been made to secure efficient factory operation. Among the points to be emphasized is that all inspectors report directly to the chief engineer. This, according to officials of the Van Dorn company, is necessary, as if these men reported to the production department there might be a tendency to "get out the work by overlooking slightly defective parts."

Jack Used to Straighten Poles

A jack which has proved an efficient means of straightening or pulling poles is a product of Templeton, Kenley & Company, Limited, of Chicago. The device, as shown, is operated by one man and works when inclined at an angle of 45 deg. In the instance illustrated sixteen strokes of the lever pushed the pole into a vertical position. The I-beam base prevented ground slippage and the cap of the rack bar formed a dependable truss. Jacking, sighting and tamping can all be done by one man. The manufacturers suggest the use of their jack to avoid the danger of internal strains, which might cripple the men when such a device is not used.

SIXTEEN STROKES MADE POLE VERTICAL

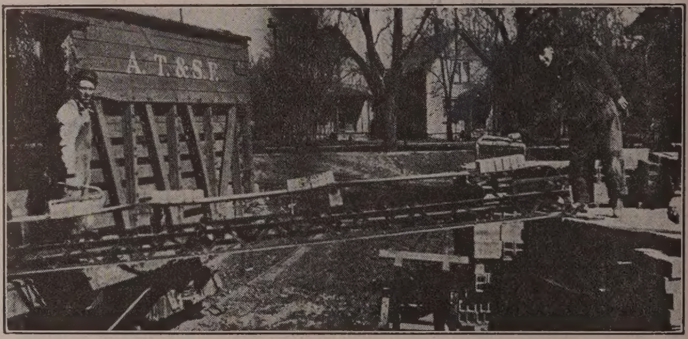
Pine Export Company to Investigate European Markets

The Yellow Pine Export Lumber Company was recently organized at New Orleans for the purpose of extending American lumber markets in Europe and South America. The company will have a large capital and through co-operation of all of the mills of the company a lumber order of any size will be handled by the mills as a collective group. It is the intention of the new company to send special agents to South America, and to Europe following the declaration of peace.

Portable Conveyor Reduces Cost of Unloading Material

A portable conveyor designed for use by coal dealers will probably interest contractors who handle much material. The machine illustrated is said to have reduced the cost of unloading by almost 50 per cent. Aside from this saving, the large gondola cars and increasing distance required between the cars and the unloading point have made it nearly impossible for one man to shovel from the car to the farthest point of the dumping ground.

The device is manufactured by the Stephen-Adamson Manufacturing Company of Aurora, Ill. It has an 18-in. belt conveyor, which measures 16 ft. from center to center. A 2-hp. covered motor supplies the power, and a pair of trucks permit easy moving. One user states that two men moved 1465 brick in an hour with the machine. A car was loaded with 648 sacks of cement in 1 hour 56 minutes.



CONVEYOR UNLOADS 1465 BRICK IN AN HOUR AND LOADS 648 SACKS OF CEMENT IN LESS THAN TWO HOURS

John Scott Medals Awarded

Acting on the recommendation of the Franklin Institute, the city of Philadelphia, recently awarded John Scott legacy medals and premiums to John V. N. Dorr, president of the Dorr Cyanide Machinery Company, of New York City, and to Carl E. Akeley, sculptor, naturalist and African explorer, who is connected with the American Museum of Natural History.

The basis of the award to Mr. Dorr was the invention of the Dorr classifier—for separating quick from slow-settling materials when both are suspended in a liquid, the Dorr thickener, for dewatering slimy material, when suspended in a liquid, and the Dorr agitator, for maintaining slimy material in suspension.

The award was made to Mr. Akeley for the invention of the Cement Gun, manufactured by the Cement Gun Company, of New York City.

Patents Issued on Colloidal Bitumens

United States patents have been issued to Clifford Richardson on an improved "bituminous substance" and on the process of manufacture. Similar patents have also been granted in Canada, Great Britain, France and Italy. It is believed that these are the first covering a product and process involving the introduction of colloidal matter into bitumens of all types. The process consists of the introduction of clay in the form of a colloidal aqueous paste and combines this paste with the bitumen in such a way that after the water is driven off, the bitumen forms the continuous phase of the colloidal material.

Outline for Study of Bitumens

The Barber Asphalt Paving Company has published an "Outline for the Study of Bitumens," arranged in convenient question and answer form with space for additional memoranda. While the whole subject of bitumens is covered, the outline has been prepared with especial reference to the asphaltic materials used in highway construction. The booklet contains references to most of the standard text books on highway engineering and is a convenient reference.

Business Notes

B. A. Brennan, formerly contract manager of the Westinghouse Machine Company and later sales manager of the power department of the Bethlehem Steel Company, has resigned as vice-president of the Mercantile Trust Company of St. Louis to accept the presidency of the Citizens Company, Incorporated, of Baltimore.

A. Leschen & Sons Rope Company, of St. Louis, is constructing a $100,000 administration building adjoining its factory. The new structure will be 75 x 115 ft. with three stories and basement. The top floor will be devoted to a restaurant; recreation rooms and shower baths will occupy the basement.

Parsons Company of Newton, Iowa, has removed its New York office to 18 West Thirty-fourth Street.

Troy Wagon Works Company has just established a connection with R. P. Carroll of Cleveland, Ohio, who will act as local district manager and will handle an entire line of Troy motor truck trailers.

A. M. Anderson, Chicago sales representative of the Oshkosh Manufacturing Company, has removed to 605 South Dearborn Street.

F. Raniville Company of Grand Rapids, Mich., has opened a New York office at 6 Church Street, in charge of George S. Baker. A complete stock of the company's goods will be maintained at the new branch.

Badger Meter Manufacturing Company of Milwaukee recently sold 2500 water meters to Kansas City, Mo.

Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio, has three additional licensees. They are the Streator Clay Manufacturing Company, Streator, Ill., which has a daily capacity of 60,000 paving block, the Martinsville Brick Company, of Martinsville, Ind., with a daily productive capacity of 30,000, and the Cleveland Brick Clay Company.

Robert C. Clifford, who for the last four years has been district sales manager for the United States Cast Iron Pipe & Foundry Company, is now associated with the Walter A. Zelnicker Supply Company, St. Louis, in charge of the rail department.